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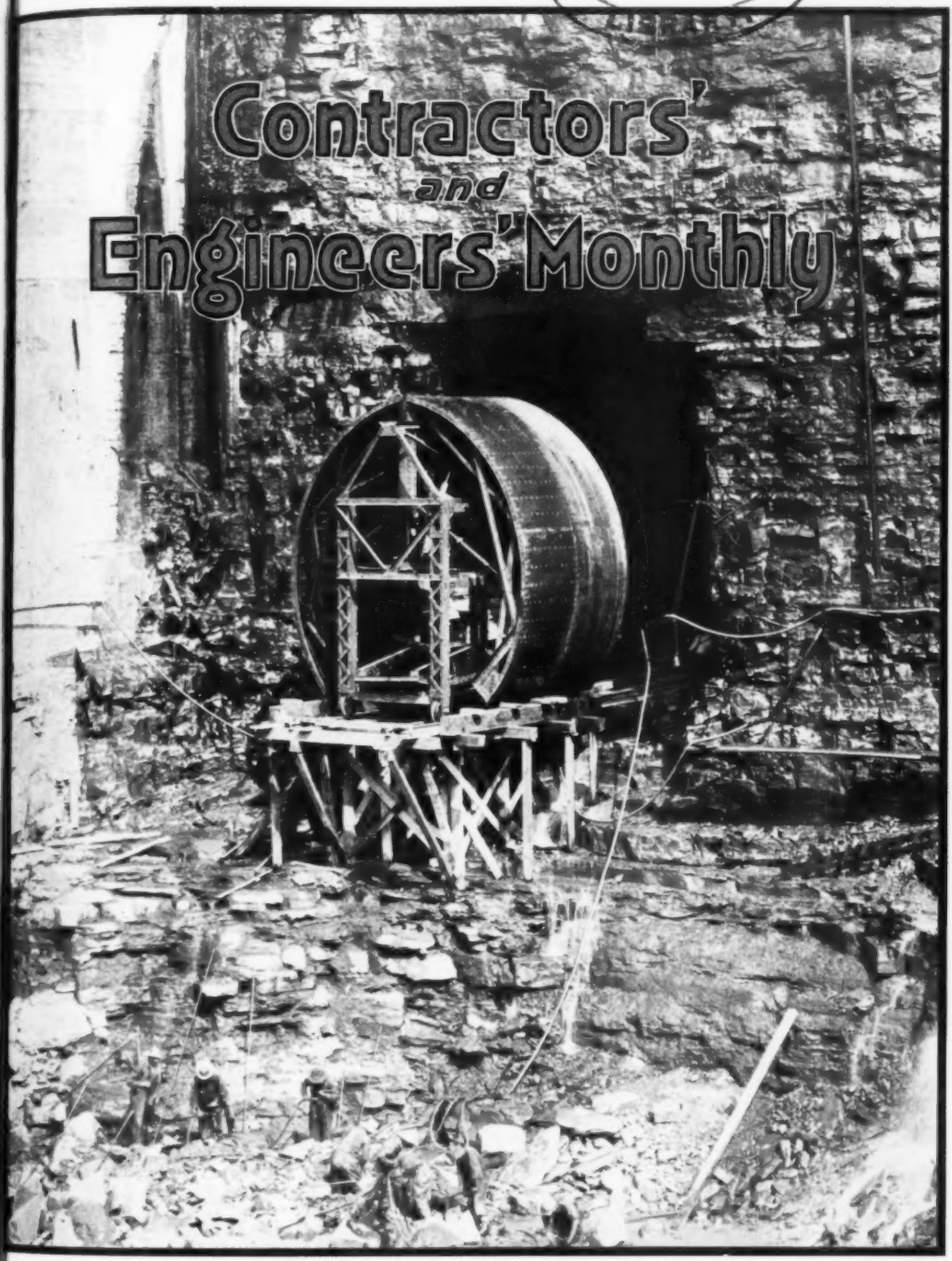
Contractors' and Engineers' Monthly



Construction View of Niagara Falls Power Tunnel, Recently Completed

This tunnel, which is horseshoe shaped, measures 32 by 32 feet, and was driven through tough limestone

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VOL. VI. No. 6 CONTRACTORS' & ENGINEERS' MONTHLY JUNE, 19
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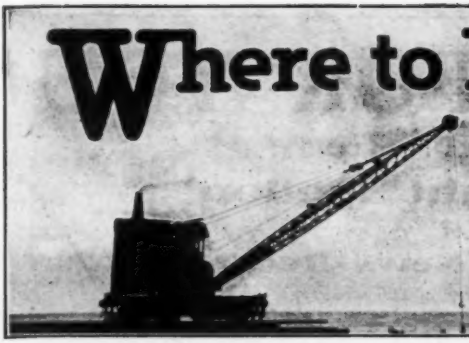

A comprehensive classification of the leading machinery and supply manufacturers arranged for the convenience of contractors, engineers and public officials who may wish to secure information about construction equipment. A star (*) before the manufacturer's name indicates that his advertisement appears in this issue.

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Headley Good Roads Co., Philadelphia, Pa.
Ky. Rock Asphalt Co., Louisville, Ky.
New Orleans Refining Co., New Orleans, La.
Sinclair Ref. Co., Chicago, Ill.
Standard Oil Co. of Calif., San Francisco, Cal.
Standard Oil Co. of La., New Orleans, La.
Standard Oil Co. of N. J., Newark, N. J.
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*Connery & Co., Philadelphia, Pa.
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Buffalo Forge Co., Buffalo, N. Y.
Concrete Steel Co., New York.
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*Universal Road Machinery Co., Kingston, N. Y.
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Heine Boiler Co., St. Louis, Mo.
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Lamson & Sessions Co., Cleveland, Ohio.
Maryland Bolt & Forge Co., Baltimore, Md.
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Browning Co., Cleveland, O.
Hayward Co., New York.
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Russell & Erwin Mfg. Co., New Britain, Conn.
Sargent & Co., New Haven, Conn.
Stanley Works, New Britain, Conn.
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Southern Rome Co., Baltimore, Md.

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Street Bros. Mach. Wks., Chattanooga, Tenn.
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Petroleum Iron Works Co., Sharon, Pa.

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*Solvay Process Co., Solvay, N. Y.
Carbondale Calcium Co., Carbondale, Pa.

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Safety Sanitary Rubbish Box Co., Columbus, O.
Solar-Sturges Mfg. Co., Chicago, Ill.
Steel Basket Co., Cedar Rapids, Iowa.

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Hunt Co., C. W., W. New Brighton, N. Y.
Insley Mfg. Co., Indianapolis, Ind.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Lakewood Engineering Co., Cleveland, O.
Light Ry. Equipment Co., Philadelphia, Pa.
Oliver Mfg. Co., W. J., Knoxville, Tenn.
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United Iron Works, Kansas City, Mo.
Weller Mfg. Co., Chicago, Ill.
Whiting Corp'n, Harvey, Ill.

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*Smith Co., T. L., Milwaukee, Wis.
*Sterling Wheelbarrow Co., Milwaukee, Wis.
Akron Barrow Co., Cleveland, Ohio.
Etnyre & Co., E. D., Oregon, Ill.
Gray Iron Fdry. Co., Reading, Pa.
Insley Mfg. Co., Indianapolis, Ind.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
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Portable Machinery Co., Passaic, N. J.
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Klauer Mfg. Co., Dubuque, Iowa.
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Sessions Foundry Co., Bristol, Conn.
South Bend Foundry Co., South Bend, Ind.

CATCH BASINS (See Castings, Street and Sewer)

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Klauer Mfg. Co., Dubuque, Iowa.
Mesker & Co., Geo. L., Evansville, Ind.
Milwaukee Corrugating Co., Milwaukee, Wis.
Wheeling Corrugating Co., Wheeling, W. Va.

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Bath Portland Cement Co., Philadelphia, Pa.
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Bessemer Limestone and Cement Co., Youngstown, O.
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Canada Cement Co., Ltd., Montreal, Canada.
Cape Girardeau Portland Cement Co., Cape Girardeau, Mo.
Castalia Portland Cement Co., Pittsburgh, Pa.
Clinchfield Portland Cement Corp., Kingsport, Tenn.
Colorado Portland Cement Co., Denver, Colo.
Continental Portland Cement Co., St. Louis, Mo.
Coplay Cement Manufacturing Co., Coplay, Pa.
Cowell Portland Cement Co., San Francisco, Cal.
Crescent Portland Cement Co., Wampum, Pa.
Dewey Portland Cement Co., Kansas City, Mo.
Dexter Portland Cement Co., Nazareth, Pa.
Diamond Portland Cement Co., Cleveland, Ohio.
Dixie Portland Cement Co., Chattanooga, Tenn.
Edison Portland Cement Co., New York.
Fredonia Portland Cement Co., Fredonia, Kans.
Giant Portland Cement Co., Philadelphia, Pa.
Gilmore Portland Cement Corp., Gilmore City, Iowa.
Glens Falls Portland Cement Co., Glens Falls, N. Y.
Golden State Portland Cement Co., Los Angeles, Cal.
Gulf States Portland Cement Co., Demopolis, Ala.
Hawkeye Portland Cement Co., Des Moines, Ia.
Helderberg Cement Co., Albany, N. Y.
Hercules Cement Corp., Philadelphia, Pa.
Indiana Portland Cement Co., Indianapolis, Ind.
International Portland Cement Co., Ltd., Spokane, Wash.
Knickerbocker Portland Cement Co., Inc., New York.
Kosmos Portland Cement Co., Louisville, Ky.
Lawrence Portl'd Cement Co., Northampton, Pa.
Lehigh Portland Cement Co., Allentown, Pa.
Louisville Cement Co., Louisville, Ky.
Marquette Cement Mfg. Co., Chicago, Ill.
Missouri Portland Cement Co., St. Louis, Mo.
Monarch Cement Co., Humboldt, Kans.
Nazareth Cement Co., Nazareth, Pa.
Newaygo Portland Cement Co., Newaygo, Mich.
Nebraska Cement Co., Denver, Colo.
New Egyptian Portland Cement Co., Fenton, Mich.
New York & New England Cement & Lime Co., New York.
Northwestern States Portland Cement Co., Mason City, Ia.
Ogden Portland Cement Co., Ogden, Utah.
Oklahoma Portland Cement Co., Denver, Colo.
Old Mission Portland Cement Co., San Francisco, Cal.
Olympic Portl'd Cement Co., Ltd., Seattle, Wash.
Oregon Portland Cement Co., Portland, Ore.
Pacific Portland Cement Co., San Francisco, Cal.
Peerless Portland Cement Co., Union City, Mich.
Peninsular Portland Cement Co., Cement City, Mich.
Penn-Allen Cement Co., Allentown, Pa.
Petoskey Portland Cement Co., Petoskey, Mich.
Phœnix Portland Cement Co., Nazareth, Pa.
Portland Cement Co. of Utah, Salt Lake City, Utah.
Pyramid Portland Cement Co., Des Moines, Ia.
Riverside Portl'd Cement Co., Los Angeles, Cal.
San Antonio Portland Cement Co., San Antonio, Tex.
Sandusky Cement Co., Cleveland, Ohio.
Santa Cruz Portland Cement Co., San Francisco, Cal.
Security Cement and Lime Co., Hagerstown, Md.
Signal Mountain Portland Cement Co., Chattanooga, Tenn.
Southern States Portland Cement Co., Rockport, Ga.
Southwest'n Portland Cement Co., El Paso, Tex.
Standard Portland Cement Corp., San Francisco, Calif.
Superior Portland Cement Co., Seattle, Wash.
Texas Portland Cement Co., Dallas, Tex.
Three Forks Portland Cement Co., Denver, Colo.
Tidewater Portland Cement Co., Baltimore, Md.
Trinity Portland Cement Co., Dallas, Tex.
Union Portland Cement Co., Ogden, Utah.
United States Potash Co., Los Angeles, Cal.
U. S. Portland Cement Co., Denver, Colo.
Universal Portland Cement Co., Chicago, Ill.
Vulcanite Portland Cement Co., Philadelphia, Pa.
Wabash Portland Cement Co., Detroit, Mich.
Wellston Iron Furnace Co., Jackson, Ohio.
Western States Portland Cement Co., Independence, Kans.
Whitehall Cement Mfg. Co., Philadelphia, Pa.
Wolverine Portl'd Cement Co., Coldwater, Mich.
Wyandotte Portland Cement Co., Detroit, Mich.

CEMENT GUNS

Cement Gun Co., Allentown, Pa.

CEMENT INSPECTION (See Inspecting Laboratories)

CHAINS

American Chain Co., Inc., Bridgeport, Conn.
Chain Belt Co., Milwaukee, Wis.
Columbus McKinnon Chain Co., Columbus, O.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
Niagara Metal Stamp Corp., Niagara Falls, N. Y.
U. S. Chain & Forge Co., Pittsburgh, Pa.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

CHECK VALVES

*Ludlow Valve Mfg. Co., Troy, N. Y.
Columbian Iron Works, Chattanooga, Tenn.
Lunkenheimer Co., Cincinnati, O.
Mueller Mfg. Co., H., Decatur, Ill.

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Du Pont de Nemours & Co., E. I., Wilmington, Del.
Electro Bleaching Gas Co., New York.
General Chemical Co., New York.
Mathieson Alkali Works, Inc., New York.
Penna. Salt Mfg. Co., Philadelphia, Pa.

*Indicates that the manufacturer carries an advertisement. See index facing inside back cover.

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Wood-Detroit Hydraulic Hoists and Steel Bodies are playing a big part in building thousands of miles of better highway. Far more trucks in this work are Wood-Detroit equipped than with all other power hoists combined.

WOOD DETROIT

This universal use, the endorsement of over 90% of the truck makers, and the record of success of the last decade all attest the superiority of this equipment.

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Rust Engineering Co., Pittsburgh, Pa.
Weber Chimney Co., Chicago, Ill.

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American Chimney Corp., New York
Custodis Chimney Const. Co., Alphons, New York.
Heine Chimney Co., Chicago, Ill.
Heinicke, Inc., H. R., Indianapolis, Ind.
Kellogg & Co., M. W., New York.
Rust Engineering Co., Pittsburgh, Pa.

CHIMNEYS, STEEL (See Stacks, Steel)

CHLORINATORS

*Wallace & Tiernan Co., Inc., Newark, N. J.

CHLORINE, LIQUID (See Liquid Chlorine)

CHUTES, CONCRETE

*Ransome Concrete Mchy. Co., Dunellen, N. J.
Akron Barrow Co., Cleveland, Ohio
Insley Mfg. Co. Indianapolis, Ind.
Lakewood Engineering Co., Cleveland, O.

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American Hoist & Derrick Co., St. Paul, Minn.
Marion Malleable Iron Works, Marion, Ind.
Mockbee & Co., C. M., Cincinnati, O.
Roebling Sons Co., J. A., Trenton, N. J.
Upson-Walton Co., Cleveland, O.

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*Good Roads Mach'y Co., Kennett Square, Pa.
*Haiss Mfg. Co., Geo., New York.
*Robins Conv. Belt Co., New York.
Barber-Greene Co., Aurora, Ill.
Bartlett & Snow Co., C. O., Cleveland, Ohio.
Brown Hoisting Mchy. Co., Cleveland, O.
Chain Belt Co., Milwaukee, Wis.
Fairfield Engineering Co., Lancaster, Ohio.
Gifford-Wood Co., Hudson, N. Y.
Hunt Co., Inc., C. W., West New Brighton, N. Y.
Jeffrey Mfg. Co., Columbus, O.
Kon-Wald Co., Buffalo, N. Y.
Lidgerwood Mfg. Co., New York.
Link-Belt Co., Chicago, Ill.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Portable Machinery Co., Passaic, N. J.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

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*Union Water Meter Co., Worcester, Mass.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Glauber Brass Mfg. Co., Cleveland, O.
Haydenville Co., Haydenville, Mass.
Mueller Mfg. Co., H., Decatur, Ill.

COLUMN CLAMPS

*Sterling Wheelbarrow Co., Milwaukee, Wis.
Hydraulic Steelcraft Co., Cleveland, O.
Insley Mfg. Co., Indianapolis, Ind.
Universal Form Clamp Co., Chicago, Ill.

COMPRESSORS, AIR (See Air Compressors)

CONCRETE FLOOR HARDENER

*Truscon Laboratories, Detroit, Mich.
Anti-Hydro Waterproofing Co., Newark, N. J.
General Chemical Co., New York.
General Fireproofing Co., Youngstown, Ohio.
Granitex Corp., New York.
Horn Co., A. C., Long Island City, N. Y.
Master Builders Co., Cleveland, O.
Sonneborn Sons, Inc., L., N. Y. "Lapidolith"

CONCRETE MIXERS

*American Cement Mchy. Co., Inc., Keokuk, Ia.
*Austin Machinery Corp'n, Toledo, O.
*Jaeger Machine Co., Columbus, O.
*Atlas Eng. Co., Milwaukee, Wis.
*Koehring Co., Milwaukee, Wis.
*Ransome Concrete Mchy. Co., Dunellen, N. J.
*Smith Co., T. L., Milwaukee, Wis.
Badger Concrete Mixer Co., Milwaukee, Wis.
Chain Belt Co., Milwaukee, Wis.
Construction Mach'y Co., Waterloo, Iowa.
Contractors' Equipment Co., Keokuk, Ia.
Foote Concrete Mchy. Co., Chicago, Ill.
Gray Iron Fdry Co., Reading, Pa.
Judy Mfg. Co., Centerville, Ia.
Knickerbocker Co., Jackson, Mich.
Lakewood Engineering Co., Cleveland, O.
Lansing Co., Lansing, Mich.
Marsh-Capron Co., Chicago, Ill.
Milwaukee Concrete Mixer Co., Milwaukee, Wis.
Oshkosh Mfg. Co., Oshkosh, Wis.
Republic Iron Works, Tecumseh, Mich.
Schramm, Inc., West Chester, Pa.
Standard Scale & Supply Co., Pittsburgh, Pa.
Truckmixer Co., Milwaukee, Wis.
Worthington Pump & Mach'y Corp., New York.

CONCRETE PILING. (See Piling, Concrete)

CONCRETE REINFORCEMENT

*Truscon Steel Co., Youngstown, O.
American Steel & Wire Co., Chicago, Ill.
Bethlehem Steel Co., Bethlehem, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Concrete Steel Co., New York.
Consolidated Expanded Metal Co., Braddock, Pa.
Corrugated Bar Co., Inc., Buffalo, N. Y.
Electric Welding Co., Pittsburgh, Pa.
General Fireproofing Co., Youngstown, O.
Inland Steel Co., Chicago, Ill.
National Steel Fabric Co., Pittsburgh, Pa.
Ryerson & Son., J. T., Chicago, Ill.
Wickwire Spencer Steel Corp., New York.
Youngstown Pressed Steel Co., Warren, O.
Youngstown Sheet & Tube Co., Youngstown, O.

CONCRETE ROAD FINISHERS

*Dunn Road Mach. Co., Conneaut, Ohio.
Lakewood Eng. Co., Cleveland, Ohio

CONCRETE TOOLS

*Dallett Co., Thos. H., Philadelphia, Pa.

CONDENSERS

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Dean Bros. Steam Pump Wks., Indianapolis, Ind.
Ingersoll-Rand Co., New York.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.
Wheeler Condenser & Eng. Co., Carteret, N. J.
Worthington Pump & Mach'y Corp., New York.

CONDUIT RODS

Bissell Co., F., Toledo, Ohio.
Turbine Sewer Machine Co., Milwaukee, Wis.
Waldo Bros. & Bond Co., Boston, Mass.

CONDUITS, INTERIOR

American Circular Loom Co., Boston, Mass.
Central Tube Co., Pittsburgh, Pa.
National Metal Molding Co., Pittsburgh, Pa.
Youngstown Sheet & Tube Co., Youngstown, O.

CONDUITS, UNDERGROUND

American Vitrified Products Co., Akron, Ohio.
Dickey Clay Mfg. Co., W. S., Kansas City, Mo.
Fibre Conduit Co., Orangeburg, N. Y.
Johns-Manville, Inc., New York.
National Fireproofing Co., New York.

CONTRACTORS' SUPPLY DEALERS
(See pages 101-116)

CONTRACTORS' USED EQUIPMENT

*Haetten Co., J. E., New York.
*Spiro & Co., Maxwell, New York City

CONVEYORS, BELT

*Good Roads Mach'y Co., Kennett Square, Pa.
*Haiss Mfg. Co., Geo., New York.
*Robins Conv. Belt Co., New York.
*Russell Grader Mfg. Co., Minneapolis, Minn.
Barber-Greene Co., Aurora, Ill.
Chain Belt Co., Milwaukee, Wis.

For CONCRETE CURING

CALCIUM CHLORIDE

THE OLD, laborious and expensive method of curing concrete by ponding or by blanketing with dirt and straw and sprinkling with water is entirely done away with by the up-to-date Calcium Chloride method of concrete curing.

Solvay free-running Calcium Chloride is applied direct to the bare concrete, and requires no further attention, no sprinkling, no dirt, no straw. Roads are ready for service in as little as 10 days time. Ordinary laborers with hand shovels do the work quickly and efficiently.

The proper amount of moisture is automatically and chemically maintained and this relieves the engineer of the responsibility of inspecting for proper sprinkling each day; the contractor also is benefited because results are certain, quick O. K'ing of the road is assured and his money comes in so much sooner. The Solvay method is the right way for all; saves time, money, labor,—gives the community its road sooner and assures long wearing concrete.

use **SOLVAY**
Free Running
Calcium Chloride

Used on the Ideal Section of the Lincoln Highway and endorsed by leading engineers in every state in which it has been used. Shipped in 375 lb. non-returnable drums or easy to handle 100-lb. moisture proof bags from fifty convenient distribution points in the United States.

Write us your specific problems, our engineers will be glad to help you. Illustrated folder free on request. Write!

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Goodyear Tire & Rubber Co., Akron, O.
Imperial Belting Co., Chicago, Ill.
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Link-Belt Co., Chicago, Ill.
Olson & Co., Sam'l, Chicago, Ill.
Portable Machinery Co., Passaic, N. J.
Republic Rubber Co., Youngstown, O.
Standard Conveyor Co., No. St. Paul, Minn.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

CONVEYORS, BUCKET

*Atlas Engineering Co., Milwaukee, Wis.
*Good Roads Mach'y Co., Kennett Square, Pa.
*Haiss Mfg. Co., Geo., New York.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Robins Conv. Belt Co., New York.
Bartlett & Snow Co., C. O., Cleveland, O.
Caldwell & Son, H. W., Chicago, Ill.
Chain Belt Co., Milwaukee, Wis.
Fairfield Engineering Co., Lancaster, Ohio.
Gifford Wood Co., Hudson, N. Y.
Godfrey Conveyor Co., Elkhart, Ind.
Guarantee Constn. Co., New York.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Olson & Co., Sam'l, Chicago, Ill.
Republic Rubber Co., Youngstown, O.
Stephens Adamson Mfg. Co., Aurora, Ill.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

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Alvey-Ferguson Co., Cincinnati, O.
Dow Co., Louisville, Ky.
Lamson Co., Syracuse, N. Y.
Mathews Gravity Carrier Co., Elwood City, Pa.
Standard Conveyor Co., No. St. Paul, Minn.

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*Koehring Co., Milwaukee, Wis.
*Pawling & Harnischfeger Co., Milwaukee, Wis.
American Hoist & Derrick Co., St. Paul, Minn.
Brown Hoisting Mchy. Co., Cleveland, O.
Browning Co., Cleveland, O.
Bucyrus Co., South Milwaukee, Wis.
Byers Machine Co., Ravena, O.
Davenport Locomotive Works, Davenport, Ia.
Erie Steam Shovel Co., Erie, Pa.
Hanna Eng. Works, Chicago, Ill.
Industrial Works, Bay City, Mich.
Link-Belt Co., Chicago, Ill.
Locomotive Crane Co. of America, Champaign, Ill
Marion Steam Shovel Co., Marion, O.
McMyler Interstate Co., Cleveland, O.
Northwest Engineering Works, Chicago, Ill.
Orton & Steinbrenner Co., Chicago, Ill.
Ohio Locomotive Crane Co., Bucyrus, O.
Osgood Co., The, Marion, O.
Overland Crane Co., Hammond, Ind.
Thew Shovel Co., Lorain, O.
U. S. Crane Co., Chicago, Ill.

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*Pawling & Harnischfeger Co., Milwaukee, Wis.
Alliance Machine Co., Alliance, O.
Chesapeake Iron Wks., Baltimore, Md.
Cleveland Crane & Eng. Co., Kenton, O.
Champion Engineering Co., Kenton, O.
Milwaukee Electric Crane Co., Milwaukee, Wis.
Morgan Engineering Co., Alliance, O.
Northern Eng. Works, Detroit, Mich.
Shaw Crane Works, Muskegon, Mich.
Shepard Elec. Cr. & Hst. Co., Montour Falls, N.Y.
Toledo Crane Co., Bucyrus, O.
Whiting Fdry. & Equip. Co., Harvey, Ill.

CRANES, WRECKING

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Bucyrus Co., South Milwaukee, Wis.
Industrial Works, Bay City, Mich.

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American Creosoting Co., New York.
American Creosote Works, Inc., N. Orleans, La.
Carter Bloxonend Flooring Co., Kansas City, Mo.
Colonial Creosoting Co., Inc., Bogalusca, La.
Creosoted Materials Co., New Orleans, La.
Georgia Creosoting Co., Brunswick, Ga.
Jennison-Wright Co., Toledo, O.
Midland Creosoting Co., Granite City, Ill.
Republic Creosoting Co., Indianapolis, Ind.
Southern Paving Constr. Co., Chattanooga, Tenn.
Southern Wood Pres. Co., Atlanta, Ga.
Wyckoff Pipe & Creosoting Co., New York.

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Barrett Co., New York.
Jennison-Wright Co., Toledo, O.
Southern Creosoting Co., Ltd., Slidell, La.
Southern Paving Const. Co., Chattanooga, Tenn.
Wyckoff Pipe & Creosoting Co., New York.

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Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Buchanan Co., C. G., New York.
Traylor Eng. & Mfg. Co., Allentown, Pa.
Worthington Pump & Machy. Corp., New York.

CRUSHERS, ROCK

*Austin-Western Road Mach. Co., Chicago, Ill.
*Galion Iron Wks. & Mfg. Co., Galion, Ill.
*Good Roads Machinery Co., Kennett Square, Pa.
*Universal Road Machinery Co., Kingston, N. Y.
Acme Road Machy. Co., Frankfort, N. Y.
Case Threshing Mach. Co., J. I., Racine, Wis.
Chalmers & Williams, Chicago Hts., Ill.
Kennedy-Van Saun Mfg. & Eng. Corp., New York.
Lewistown Fdry. & Mach. Co., Lewistown, Pa.
McLanahan Stone Mach. Co., Hollidaysburg, Pa.
Morgan Engineering Co., Alliance, O.
New Holland Mach. Co., New Holland, Pa.
Smith Eng. Wks., Milwaukee, Wis.
Sturtevant Mill Co., Boston, Mass.
Universal Crusher Co., Cedar Rapids, Ia.

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*Austin-Western Rd. Mach. Co., Chicago, Ill.
*Galion Iron Works & Mfg. Co., Galion, Ohio.
*Good Roads Machinery Co., Kennett Square, Pa.
*Newport Culvert Co., Newport, Ky.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*U. S. C. I. Pipe & Fdry. Co., Burlington, N. J.
American Cast Iron Pipe Co., Birmington, Ala.
Canton Culvert & Silo Co., Canton, O.
Concrete Form Co., Inc., Syracuse, N. Y.
Dee Co., W. E., Chicago, Ill.
Dominion Metal Products Corp., Roanoke, Va.
Florida Metal Products Co., Jacksonville, Fla.
Hardesty Mfg. Co., The R., Denver, Colo.
Klauer Mfg. Co., Dubuque, Ia.
Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
Madison Foundry Co., Cleveland, O.
Southern Metal Culvert Co., Salisbury, N. C.
Wheeling Corrugating Co., Wheeling, W. Va.
Wood & Co., R. D., Philadelphia, Pa.

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*Clark Co., H. W., Mattoon, Ill.
Casey-Hedges Co., Chattanooga, Tenn.
Clow & Sons, J. B., Chicago, Ill.
Foundry Mfg. Co., St. Albans, Vt.
Madison Foundry Co., Cleveland, O.
Mueller Mfg. Co., Decatur, Ill.
Thompson-Fleming Co., Inc., Buffalo, N. Y.

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Godwin Co., W. S., Baltimore, Md.

CURB, STEEL PROTECTED

*Truscon Steel Co., Youngstown, O.
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National Steel Fabric Co., Pittsburgh, Pa.
Steel Protected Concrete Co., Philadelphia, Pa

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Armstrong Mfg. Co., Bridgeport, Conn.
Barnes Tool Co., New Haven, Conn.
Erie Tool Works, Erie, Pa.
Greenfield Tap & Die Corp'n., Greenfield, Mass.
Oswego Tool Co., Oswego, N. Y.
Reed Mfg. Co., Erie, Pa.
Walworth Mfg. Co., Boston, Mass.

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Buffalo Forge Co., Buffalo, N. Y.
Carolus Mfg. Co., Sterling, Ill.
Carpenter & Co., Geo. B., Chicago, Ill.
Helwig Mfg. Co., St. Paul, Minn.
Worthington Pump & Mchy. Corp., New York.

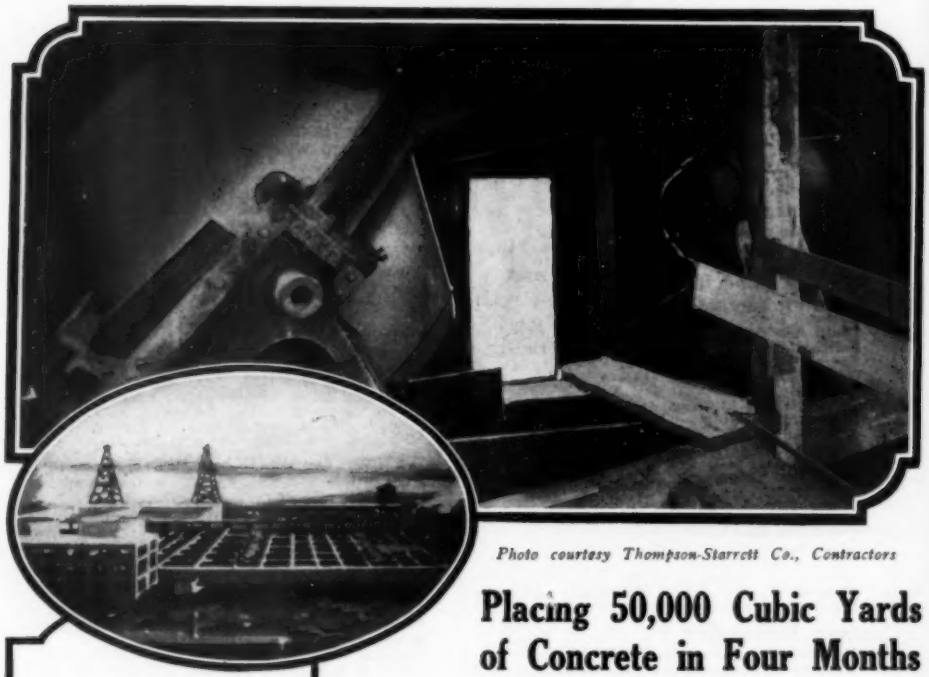

Photo courtesy Thompson-Starrett Co., Contractors

Placing 50,000 Cubic Yards of Concrete in Four Months

The 50,000 cu. yds. of concrete used in the substructure of the Detroit Filter Plant were mixed in Smith Tilting Mixers shown above, located at a central mixing plant.

The pull of a lever tilts the mixer and the mixed concrete flows rapidly into waiting 5-ton buckets which carry it to the job.

For this sort of work nothing has been yet devised but the Smith Tilting Mixer for thoroughness of mix combined with speed of discharging.

Over 15,000 of this one type of Smith Mixer are in use in all parts of the world—the world's largest mixers being of this type—used at Muscle Shoals.

Smith Tilting Mixers are made in standard sizes of 10, 21, 28, and 56 cu. yds. mixed batch capacities. They are described in Bulletin 406. Copy sent to you at your request.

A Smith-Mixed Concrete Job is a lasting monument to the contractor's integrity.

Though quiet in action (a reason for unusual long life) the end-to-center mixing of the aggregate produces the thorough hydrating and coating necessary to insure enduring concrete. Smith-mixed concrete a quarter-of-a-century old has proven that this thorough mixing is important—and concrete in use, exposed to wear, vibration, and all kinds of weather provides a far better test of value than all laboratory tests put together.

The Smith drum is a clean drum, made of boiler plate steel, so that there are no accumulations or clogging to interfere with the thorough end-to-center mixing action.

THE T. L. SMITH COMPANY

1021 32nd Street, Milwaukee, Wis.

New York Office and Warehouse: 50 Church Street
Chicago Office: Old Colony Building
Western Warehouse: Oakland, California
Agents in Principal Cities

SMITH MIXERS

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Milburn Co., Alexander, Baltimore, Md.
Prest-O-Lite Co., Inc., New York.

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American Hoist & Derrick Co., St. Paul, Minn.
Byers Machine Co., Ravenna, O.
Carpenter & Co., Geo. B., Chicago, Ill.
Clyde Iron Works Sales Co., Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Federal Bridge & Struc. Co., Waukesha, Wis.
Flory Mfg. Co., S., Bangor, Pa.
Horton Co., John T., New York.
Insley Mfg. Co., Indianapolis, Ind.
Lakeside Bridge & Steel Co., N. Milwaukee, W
Lidgerwood Manufacturing Co., New York.
Lincoln Iron Works, Rutland, Vt.
National Hoisting Engine Co., Harrison, N. J
Saagen Derrick Co., Chicago, Ill.
Smith, Whitcomb & Cook Co., Barrie, Vt.
Superior Iron Works, Superior, Wis.

DERRICKS, PIPE LAYING
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Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Lidgerwood Manufacturing Co., New York.
Mueller Mfg. Co., H., Decatur, Ill.

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Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Lidgerwood Manufacturing Co., New York.

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Austin Machinery Corp'n, Chicago, Ill.
Buffalo Hoist & Derrick Co., Buffalo, N. Y.
Clyde Iron Works Sales Co., Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Hayward Co., New York.
Insley Mfg. Co., Indianapolis, Ind.
Lakeside Bridge & Steel Co., N. Milwaukee, Wis.
Lidgerwood Manufacturing Co., New York.
Taylor Portable Steel Derrick Co., Chicago, Ill.

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Blaw-Knox Co., Pittsburgh, Pa.
Clyde Iron Works Sales Co., Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Lidgerwood Manufacturing Co., New York.
Taylor Portable Steel Derrick Co., Chicago, Ill.

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American Hoist & Derrick Co., St. Paul, Minn.
Bay City Dredge Works, Bay City, Mich.
Byers Machine Co., Ravenna, Ohio.
Clyde Iron Works Sales Co., Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Hayward Co., New York.
Nat'l Hoisting Engine Co., Harrison, N. J.
Orton & Steinbrenner Co., Chicago, Ill.

DIESEL ENGINES. (See Engines, Oil)

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*Ransome Concrete Mchy. Co., Dunellen, N. J.
Archer Iron Works, Chicago, Ill.
Insley Mfg. Co., Indianapolis, Ind.
Lakewood Engineering Co., Cleveland, O.

DITCHING MACHINES (See Excavators, Ditch and Trench)

DIVIDING PLATES (ROAD)
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Central Metal Products Corp., Canton, Ohio.
Dahlstrom Metallic Door Co., Jamestown, N. Y.
Friedrich Co., E. H., Holyoke, Mass.
Lawton-Stephens Co., Brooklyn, N. Y.
McFarland Co., J. C., La Porte, Ind.
Penn Metal Co., Boston, Mass.
Siester & Thomacher Co., Cleveland, Ohio.
Sykes Co., Chicago, Ill.
Thorp Fire Proof Door Co., Minneapolis, Minn.

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Cornell Iron Works, New York.
Kinnear Mfg. Co., Columbus, O.
Variety Mfg. Co., Chicago, Ill.
Wilson Corp., J. G., New York.

DRAFTING MACHINES
Universal Drafting Machine Co., Cleveland, O.

DREDGES
American Steel Dredge Co., Fort Wayne, Ind.
Bay City Dredge Works, Bay City, Mich.
Bucyrus Co., South Milwaukee, Wis.
Ellicott Machine Corp'n., Baltimore, Md.
Erie Steam Shovel Co., Erie, Pa.
Hayward Co., New York.
Lidgerwood Mfg. Co., New York.
Marion Steam Shovel Co., Marion, O.
Osgood Co., The, Marion, O.
Stockton Iron Works, Stockton, Cal.
Street Bros. Mach. Wks., Chattanooga, Tenn.
Superior Iron Works, Superior, Wis.
Vulcan Iron Works, Jersey City, N. J.

DREDGES, DIPPER
*Austin Machinery Corp'n, Toledo, O.
*Fairbanks Steam Shovel Co., Marion, O.
American Steel Dredge Co., Fort Wayne, Ind.
Bay City Dredge Works, Bay City, Mich.
Bucyrus Co., South Milwaukee, Wis.
Marion Steam Shovel Co., Marion, O.
Osgood Co., Marion, O.

DREDGES, HYDRAULIC
*Fairbanks Steam Shovel Co., Marion, O.
Bucyrus Co., South Milwaukee, Wis.
Ellicott Mach. Corp., Baltimore, Md.
Marion Steam Shovel Co., Marion, O.
Morris Machine Works, Baldwinsville, N. Y.

DREDGING PUMPS AND ACCESSORIES
Erie Pump & Engine Wks., Medina, N. Y.

DRILLS, AIR
*Dallett Co., Thos. H., Philadelphia, Pa.
*Denver Rock Drill Mfg. Co., Denver, Colo.
*McKiernan-Terry Drill Co., New York.
Chicago Pneumatic Tool Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Cleveland Rock Drill Co., Cleveland, Ohio.
Helwig Mfg. Co., St. Paul, Minn.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Sullivan Machinery Co., Chicago, Ill.

DRILLS, CORE
*McKiernan-Terry Drill Co., New York.
Dobbins Core Drill Co., Inc., New York.
Ingersoll-Rand Co., New York.
Standard Diamond Drill Co., Chicago, Ill.
Sullivan Mach'y Co., Chicago, Ill.

DRILLS, HAMMERS (PNEUMATIC)
*Denver Rock Drill Mfg. Co., Denver, Colo.
*McKiernan-Terry Drill Co., New York.
Chicago Pneumatic Tool Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Cleveland Rock Drill Co., Cleveland, O.
Ingersoll-Rand Co., New York.
Natl. Elec. Mfg. Co., Pittsburgh, Pa.
Sullivan Machinery Co., Chicago, Ill.

DRILLS, ROCK
*Dallett Co., Thos. H., Philadelphia, Pa.
*Denver Rock Drill Mfg. Co., Denver, Colo.
*McKiernan-Terry Drill Co., New York.
Chicago Pneumatic Tool Co., New York.
Cleveland Rock Drill Co., Cleveland, Ohio.
Helwig Mfg. Co., St. Paul, Minn.
Ingersoll-Rand Co., New York.
Natl. Elec. Mfg. Co., Pittsburgh, Pa.
Sullivan Machinery Co., Chicago, Ill.
Wood Drill Works, Paterson, N. J.

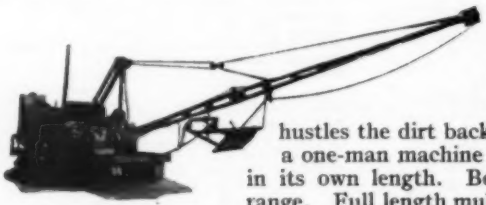
DRILLS FOR WELLS AND BLAST HOLES (See Well Drilling Machinery)

It's a Comfortable Sort of Feeling

Makes you feel kinda good to know that the company you've bought a machine from is going to take care of you. Here's a contractor way out in Los Angeles—Harper D. Churchill. He writes us:

"I chose a Buckeye after carefully checking their performance and specifications. At this instance, I wish to go on record that the Buckeye organization is the squarest and easiest to do business with that I know of. Your wants are taken care of promptly and efficiently. They make you feel as though they are interested in your welfare. This alone would make us give them all our future business."

That's putting it pretty "strong." But you'll find most Buckeye owners *strong for Buckeyes* and the *service* that goes with 'em. Put a Buckeye on your next job—you'll find we're right when we say "you'll always be glad you bought a Buckeye."



Going Down!

Cost of back-filling *going down* when a Buckeye Back-Filler hustles the dirt back where it came from. Here's a one-man machine that *one man can run*. Turns in its own length. Boom has 160 degree swinging range. Full length multiplane traction and *plenty* of *power*. Complete details in the Back-Filler Booklet. Shall we shoot you a copy—today?

The Buckeye Traction Ditcher Co., Findlay, O.

Manufacturers of Trench Excavators (both Wheel and Chain-and-Bucket Types), Pipe-Line Trench Excavators, Tile and Open Ditchers, Back-Fillers, Pipe Screwing Machines, Curb Diggers and Clay Diggers.

Branch Sales Offices:

New York	Chicago
San Francisco	Los Angeles
Tulsa, Okla.	Denver
Miami, Fla.	Mason City, Ia.
Chatham, Ont.	Salt Lake City
Winnipeg, Man.	Milwaukee

John Birch & Co., Ltd
2, London Wall Buildings,
London, E. C. 2, England

Buckeye

DRUMS, HOLDING

Blaw-Knox Co., Pittsburgh, Pa.
Clyde Iron Works Sales Co., Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Hayward Co., New York.
Monighan Machine Co., Chicago, Ill.

DRYERS, ASPHALT AND CEMENT

Allis-Chalmers Co., Milwaukee, Wis.
American Blower Co., Detroit, Mich.
American Process Co., New York.
Atlas Dryer Co., Cleveland, O.
Bartlett & Snow Co., C. O., Cleveland, O.
Cummer & Son Co., F. D., Cleveland, O.
East Iron & Machine Co., Lima, O.
Ruggles-Coles Eng. Co., New York.
Variety Iron & Steel Works, Cleveland, O

DRYERS, SAND AND GRAVEL

*Littleford Bros., Cincinnati, Ohio.

DUMP BODIES FOR MOTOR TRUCKS

*Heil Company, Milwaukee, Wis.
*International Motor Co., New York.
*Littleford Bros., Cincinnati, O.
*Wood Hydr. Hoist & Body Co., Detroit, Mich.
American Truck Body Co., Inc., Martinsville, Va
Archer Iron Works, Chicago, Ill.
Auto Truck Steel Body Co., Chicago, Ill.
Columbian Steel Tank Co., Kansas City, Mo.
Columbia Wagon & Body Co., Columbia, Pa.
Horizontal Hydraulic Hoist Co., Detroit, Mich.
Jennings Automatic Dump Body, Roanoke, Va.
Lee Trailer & Body Co., Chicago, Ill
Pechstein Iron Works, Keokuk, Iowa.
Simplex Mfg. Co., Connesutville, Pa.
Van Dorn Iron Wks., Cleveland, Ohio.

DUMP CARTS AND WAGONS, HORSE DRAWN

*Austin Western Road Mchy. Co., Chicago, Ill.
*Russell Grader Mfg. Co., Minneapolis, Minn.
Acme Road Machinery Co., Frankfort, N. Y.
Acme Wagon Co., Emigsville, Pa.
Austin Mfg. Co., Chicago, Ill.
Columbia Wagon & Body Co., Columbia, Pa.
Eagle Wagon Works, Auburn, N. Y.
Holsbog & Bro., Geo. H., Jeffersonville, Ind.
Stroud & Co., Omaha, Nebr.
Tiffin Wagon Co., Tiffin, Ohio.
Watson Products Corp., Canastota, N. Y.
Western Wheeled Scraper Co., Aurora, Ill.

DUST LAYING AND ROAD BINDER MATERIALS

*Dow Chemical Co., Midland, Mich.
*Solvay Process Co., Solvay, N. Y.
*Standard Oil Co. (Indiana), Chicago, Ill.
*Texas Co., New York.
Barrett Co., New York.
Carbondale Calcium Co., Carbondale, Pa.
Dustoline for Roads Co., Summit, N. J.

DYNAMITE (See Explosives)

EJECTORS, SEWAGE

Pacific Flush Tank Co., Chicago, Ill.
Yeomans Bros. Co., Chicago, Ill.

ELECTRIC GENERATORS AND MOTORS

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Crocker-Wheeler Co., Ampere, N. J.
Fairbanks, Morse & Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Ideal Elec. & Mfg. Co., Mansfield, O.
Lincoln Electric Co., Cleveland, O.
Robbins & Myers Co., Springfield, O.
Triumph Electric Co., Cincinnati, O.
Wagner Elec. Mfg. Co., St. Louis, Mo.
Western Electric Co., New York.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

ELECTRIC LAMPS

General Electric Co., Schenectady, N. Y.
Westinghouse Lamp Co., New York.

ELECTRIC LIGHTING PLANTS

*Climax Engineering Co., Clinton, Ia.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.
Western Electric Co., New York.

ELECTRIC SUPPLIES, METERS, ETC.

Bissell Co., F., Toledo, Ohio.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

ELECTRIC TRANSFORMERS

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Kuhlman Electric Co., Bay City, Mich.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

ELECTRIC WIRES AND CABLES. (See "Wire and Cable")

ELEVATORS, BUCKET

Atlas Eng. Co., Milwaukee, Wis.
*Austin Western Road Machy. Co., Chicago, Ill.
*Good Roads Mach'y Co., Kennett Square, Pa.
*Haiss Mfg. Co., Geo., New York.
*Littleford Bros., Cincinnati, Ohio.
*Robins Conv. Belt Co., New York.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Universal Road Machinery Co., Kingston, N. Y.
Austin Mfg. Co., Chicago, Ill.
Bartlett & Snow Co., C. O., Cleveland, Ohio.
Chain Belt Co., Milwaukee, Wis.
Fairfield Engineering Co., Lancaster, Ohio.
Gifford-Wood Co., Hudson, N. Y.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
Olson & Co., Sam'l, Chicago, Ill.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.
Worthington Pump & Mchy. Corp., New York.

ELEVATORS, PASSENGER, FREIGHT, ETC.

Albro-Clem Elevator Co., Philadelphia, Pa.
Amer. Elevator & Mach. Co., Louisville, Ky.
Bay State Elevator Co., Springfield, Mass.
Haughton Elev. & Mach. Co., Toledo, Ohio.
Kaestner & Hecht Co., Chicago, Ill.
Llewellyn Iron Works, Los Angeles, Cal.
Montgomery Elevator Co., Moline, Ill.
Otis Elevator Co., New York.
Ridgeway & Son Co., C., Coatesville, Pa.
See Elec. Elevator Co., A. B., New York.
Speidel, J. G., Reading, Pa.
Warner Elevator Mfg. Co., Cincinnati, O.
Warsaw Elevator Co., Warsaw, N. Y.

ENGINES, GAS AND GASOLINE

*Climax Engineering Co., Clinton, Ia.
*Domestic Engine & Pump Co., Shippensburg, Pa.
*Hercules Corpn., Evansville, Ind.
*Holt Mfg. Co., Peoria, Ill.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Charter Gas Eng. Co., Sterling, Ill.
Chicago Pneumatic Tool Co., New York.
Evinrude Motor Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
Foos Gas Engine Co., Springfield, Ohio.
Fuller & Johnson Mfg. Co., Madison, Wis.
Gade Bros. Mfg. Co., Iowa Falls, Iowa.
Nelson Bros. Co., Saginaw, Mich.
"New-Way" Motor Co., Lansing, Mich.
Novo Engine Co., Lansing, Mich.
Universal Motor Co., Oshkosh, Wis.
Weber Engine Co., Kansas City, Mo.
Wellman-Seaver-Morgan Co., Cleveland, O.
Worthington Pump & Mchy. Corp., New York.

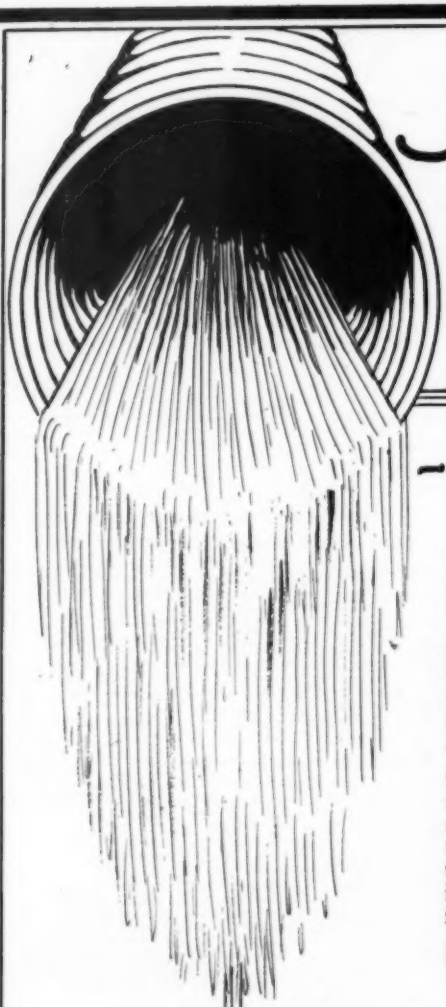
ENGINES, OIL

DIESEL

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Busch-Sulzer Bros.-Diesel Eng. Co., St. Louis, Mo.
Dodge Sales & Eng. Co., Mishawaka, Ind.
Fulton Iron Works Co., St. Louis, Mo.
Hadfield-Penfield Steel Co., Bucyrus, Ohio.
McIntosh & Seymour Corp., Auburn, N. Y.
Nordberg Mfg. Co., Milwaukee, Wis.
Western Machy. Co., Los Angeles, Cal.

SEMI-DIESEL

Anderson Fdry. & Mach. Co., Anderson, Ind.
Bessemer Gas Eng. Co., Grove City, Pa.
Buckeye Machinery Co., Lima, O
Charter Gas Eng. Co., Sterling, Ill.
Chicago Pneumatic Tool Co., New York.
De La Vergne Machine Co., New York.



Newport
RUST-RESISTING
Culverts

—A LONG LIFE AND A USEFUL ONE—

To stand up under the attacks of acid soils and other corrosive agents, culverts must be made of the most economical rust-resistant metal. Newport Culverts are made of GENUINE OPEN-HEARTH IRON, guaranteed to be 99.875 per cent pure iron copper alloy, the best rust-resistant metal on the market today for culvert service.

Our free booklet on Newport Culverts records complete chemical tests of the materials in these half-round and full-circle types of corrugated culverts. It also contains illustrated descriptions of actual installations that show accurately and forcefully the meaning of

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Newport Culvert Co.
542 West Tenth Street
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Evinrude Motor Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
Foos Gas Engine Co., Springfield, O.
Ingersoll-Rand Co., New York.
Midwest Engine Co., Indianapolis, Ind.
Muncie Oil Eng. Co., Muncie, Ind.
Nordberg Mfg. Co., Milwaukee, Wis.
St. Mary's Oil Eng. Co., St. Charles, Mo.
Stover Mfg. & Engine Co., Freeport, Ill.
Taylor Machine Co., Cleveland, O.
Weber Engine Co., Kansas City, Mo.
Worthington Pump & Mchy. Corp., New York.

ENGINES, PUMPING

*Climax Engineering Co., Clinton, Ia.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Hoover, Owen, Rentschler Co., Hamilton, O.
Murray Iron Wks., Burlington, Ia.
Nordberg Mfg. Co., Milwaukee, Wis.
Worthington Pump & Mchy. Corp., New York.

ENGINES, STEAM

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Dake Engine Co., Grand Haven, Mich.
Erie-Ball Engine Co., Pittsburgh, Pa.
Erie Pump & Engine Co., Medina, N. Y.
Filer-Stowell Co., Milwaukee, Wis.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Leffel Co., J., Springfield, O.
Morris Machine Works, Baldwinsville, N. Y.
Murray Iron Works Co., Burlington, Ia.
Nordberg Mfg. Co., Milwaukee, Wis.
Stuntevant Co., B. F., Hyde Park, Boston, Mass.
Vilter Mfg. Co., Milwaukee, Wis.

EXCAVATING MACHINERY. (See Names Under Excavators, also Steam Shovels)

EXCAVATORS, CABLEWAY

Bucyrus Co., South Milwaukee, Wis.
Lidgerwood Mfg. Co., New York.

EXCAVATORS, DITCH AND TRENCH

*Austin Machinery Corp'n, Toledo, O.
*Buckeye Traction Ditcher Co., Findlay, O.
*Fairbanks Steam Shovel Co., Marion, O.
*Keystone Driller Co., Beaver Falls, Pa.
*Pawling & Harnischfeger Co., Milwaukee, Wis.
*Russell Grader Mfg. Co., Minneapolis, Minn.
American Hoist & Derrick Co., St. Paul, Minn.
Bay City Dredge Works, Bay City, Mich.
Byers Machine Co., Ravenna, Ohio.
Ball Engine Co., Erie, Pa.
Bucyrus Co., South Milwaukee, Wis.
Clyde Iron Works Sales Co., Duluth, Minn.
Economy Excavator Co., Iowa Falls, Ia.
Erie Steam Shovel Co., Erie, Pa.
Hayward Co., The, New York City.
Marion Steam Shovel Co., Marion, O.
Monighan Machine Co., Chicago, Ill.
Osgood Co., Marion, O.
Parsons Co., Newton, Ia.

EXCAVATORS, DRAG-LINE

*Austin Machinery Corp'n, Toledo, O.
*Bay City Dredge Works, Bay City, Mich.
*Pawling & Harnischfeger Co., Milwaukee, Wis.
*Sauerman Bros., Chicago, Ill.
*Smith Co., T. L., Milwaukee, Wis.
Browning Co., Cleveland, O.
Bucyrus Co., South Milwaukee, Wis.
Byers Machine Co., Ravenna, Ohio.
Clyde Iron Works Sales Co., Duluth, Minn.
Economy Excavator Co., Iowa Falls, Ia.
Erie Steam Shovel Co., Erie, Pa.
Gade Excavator Works, C. L., Iowa Falls, Iowa
Hayward Co., New York.
Industrial Works, Bay City, Mich.
Link-Belt Co., Chicago, Ill.
Marion Steam Shovel Co., Marion, O.
Monighan Machine Co., Chicago, Ill.
Osgood Co., Marion, O.
Parsons Co., Newton, Ia.

EXPANDED METAL

*Truscon Steel Co., Youngstown, O.
Berger Mfg. Co., Canton, O.
Consolidated Expanded Metal Co., Braddock, Pa.
Corrugated Bar Co., Inc., Buffalo, N. Y.
Northwestern Expanded Metal Co., Chicago, Ill.
Youngstown Pressed Steel, Co., Warren, O.

EXPANSION JOINT MATERIAL

*Barber Asphalt Co., Philadelphia, Pa.
*Carey Co., Philip, Cincinnati, Ohio.
*Pioneer Asphalt Co., Lawrenceville, Ill.
*Servicised Products Co., Chicago, Ill.
*Texas Company, New York.
*Truscon Steel Co., Youngstown, O.
*Waring-Underwood Co., Philadelphia, Pa.
Barrett Co., New York.

EXPLOSIVES

Atlas Powder Co., Wilmington, Del.
Du Pont de Nemours & Co., E.I., Wilmington, Del.
Giant Powder Co., Cons., San Francisco, Cal.
Hercules Powder Co., Wilmington, Del.

FENCING

Adrian Wire Fence Co., Adrian, Mich.
American Steel & Wire Co., Chicago, Ill.
Anchor Post Iron Works, New York.
Cyclone Fence Co., Waukegan, Ill.
Frost-Superior Fence Co., Cleveland, O.
Indiana Steel & Wire Co., Muncie, Ind.
Nitselman Bros., Muncie, Ind.
Michigan Wire Fence Co., Adrian, Mich.
Page Steel & Wire Co., Bridgeport, Conn.
Pittsburgh Steel Co., Pittsburgh, Pa.
Stewart Iron Works Co., Cincinnati, Ohio.
Texas Cyclone Fence Co., Fort Worth, Tex.
Wickwire Spencer Steel Corp., New York.
Youngstown Sheet & Tube Co., Youngstown, O.

FILING EQUIPMENT, STEEL

Art Metal Constr. Co., Jamestown, N. Y.
Berger Mfg. Co., Canton, O.
General Fireproofing Co., Youngstown, O.
Van Dorn Iron Works, Cleveland, O.

FILTERS, OIL

Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Wayne Tank & Pump Co., Ft. Wayne, Ind.

FILTERS, WATER

American Water Softener Co., Philadelphia, Pa.
Graver Corporation, E. Chicago, Ind.
International Filter Co., Chicago, Ill.
N. Y. Continental Jewel Filtr. Co., Nutley, N. J.
Norwood Engineering Co., Florence, Mass.
Roberts Filter Co., Darby, Pa.
Scaife & Sons Co., W. B., Pittsburgh, Pa.

FIRE ALARM SYSTEMS

Gamewell Fire Alarm Tel. Co., Newton Upper Falls, Mass.

FIRE ALARM SIRENS

Erick Elec. Siren Co., St. Paul, Minn.
Federal Sign System, Chicago, Ill.
Hendrie & Bolthoff Mfg. & Sup. Co., Denver, Col.
Interstate Machine Prod. Co., Rochester, N. Y.
Sireno Co., Stapleton, N. Y.
Union Water Meter Co., Worcester, Mass.

FIRE APPARATUS, MOTOR

*International Motor Co., New York.
Ahrens-Fox Fire Engine Co., Cincinnati, O.
American-La France Fire Eng. Co., Elmira, N. Y.
Brockway Motor Fire App. Co., Cortlandt, N. Y.
Northern Fire Apparatus Co., Minneapolis, Minn.
Foamite-Childs Corp., Utica, N. Y.
Piraeh & Sons Co., Peter, Kenosha, Wis.
Prospect Mfg. Co., Prospect, O.
Seagrave Co., Columbus, O.
Stutz Fire Engine Co., Indianapolis, Ind.
Waterous Fire Engine Co., St. Paul, Minn.

FIRE EXTINGUISHERS, CHEMICAL

American-La France Fire Eng. Co., Elmira, N. Y.
Cross Mfg. Co., C. J., Inc., New York.
Foamite-Childs Co., Utica N. Y.
Pyrene Mfg. Co., Newark, N. J.

FIREPROOF BUILDING MATERIAL

*Truscon Steel Co., Youngstown, O.
Berger Mfg. Co., Canton, O.
Corrugated Bar Co., Inc., Buffalo, N. Y.
Delaware Clay Products Co., Pittsburgh, Pa.
Detroit Steel Prod. Co., Detroit, Mich.
General Fireproofing Co., Youngstown, O.

18 Models

the World's Largest Line of Concrete Mixers!

WHEN you buy your next concrete mixer, choose from the Jaeger line of 18 models and get exactly the outfit you need for your particular requirements. That's one sure way of cutting costs on concrete mixing.

Every Jaeger Mixer is the tilting-drum type—built for maximum speed in discharging! And for maximum speed in mixing! You can depend on the Jaeger you buy to deliver a Mix-a-Minute—*thoroughly mixed concrete that measures up to highest standards.*

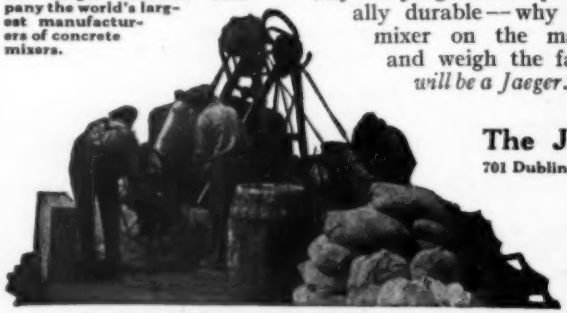
The Jaeger catalog fully explains the patented exclusive features that have made the Jaeger the world's biggest selling concrete mixer. It tells you why the Jaeger Drum has bigger capacity—why the Jaeger is far speedier—why it is exceptionally durable—why it is the biggest-value mixer on the market. Get the catalog and weigh the facts—*then your next mixer will be a Jaeger.* Write for catalog today.

For Speed, Tilt and Pour!

Over half the concrete mixers in use today are the tilting type—and Jaeger made the majority of them!

That proves two things—that Tilting Mixers are the best to buy—and that Jaeger Tilting Mixers give the best satisfaction.

For Speed—Tilt and Pour! The Tilting Drum, combined with other superior Jaeger features, has made the Jaeger Machine Company the world's largest manufacturers of concrete mixers.



The Jaeger Machine Co.
701 Dublin Ave. Columbus, Ohio

It is infringement to make, use or sell a patented invention without authority under the patent. Our patents have been sustained by the United States Courts in six different instances. Purchasers of our Mixers are protected.

JAEGER

Keasbey & Mattison Co., Ambler, Pa.
Kinnear Mfg. Co., Columbus, O.
National Fireproofing Co., Pittsburgh, Pa.
United States Gypsum Co., Chicago, Ill.
Youngstown Pressed Steel, Co., Warren, O.

FIRST AID EQUIPMENT

American-La France Fire Eng. Co., Elmira, N. Y.

FLEXIBLE JOINTS

*Central Foundry Co., New York.
*U. S. C. I. Pipe & Fdry Co., Burlington, N. J.
Coldwell-Wilcox Co., Newburgh, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
United Lead Company, New York.

FLOORING, COMPOSITION

*Barber Asphalt Co., Philadelphia, Pa.
Am. Mason Safety Tread Co., Lowell, Mass.
Barrett Co., New York.
Johns-Manville Co., H. W., New York.
Marine Decking & Supply Co., Phila., Pa.
Muller, Franklyn R., & Co., Waukegan, Ill.

FLOORS, WOOD BLOCK

*Servicised Products Co., Chicago, Ill.
Barrett Co., New York.
Carter Bloxonend Flooring Co., Kansas City, Mo.
Jennison-Wright Co., Toledo, O.
Midland Creosoting Co., Toledo, O.
Republic Creosoting Co., Indianapolis, Ind.
Sou. Wood Preserving Co., Atlanta, Ga.
Wyckoff Pipe & Creosoting Co., New York.

FLUSH TANKS

Pacific Flush Tank Co., Chicago, Ill.

FLUSHERS, STREET. (See Street Flushers and Sprinklers.)

FORGES

Buffalo Forge Co., Buffalo, N. Y.
Hauck Mfg. Co., Brooklyn, N. Y.

FORM CLAMPS

Insley Mfg. Co., Indianapolis, Ind.
Marion Malleable Iron Works, Marion, Ind.
Universal Form Clamp Co., Chicago, Ill.

FORMS, CONCRETE

*Cennery & Co., Philadelphia, Pa.
*Truscon Steel Co., Youngstown, O.
Blaw-Knox Co., Pittsburgh, Pa.
Concrete Form Co., Inc., Syracuse, N. Y.
Hetzel Steel Form & Iron Co., The, Warren, O.
Hydraulic Steelcraft Co., Cleveland, O.
Lakewood Eng. Co., Cleveland, Ohio.
Metal Forms Corp., Milwaukee, Wis.

FOUNTAINS, DRINKING

Casey-Hedges Co., Chattanooga, Tenn.
Clow & Sons, Jas. B., Chicago, Ill.
Crane Co., Chicago, Ill.
Mott Iron Wks., J. L., New York.
Murdock Mfg. & Supply Co., Cincinnati, Ohio.
Puro San. Dr. Ftn. Co., Haydenville, Mass.
Rundle-Spence Mfg. Co., Milwaukee, Wis.
Stewart Iron Works Co., Cincinnati, O.
Taylor Co., Halsey W., Warren, O.
Twentieth Century Brass Wks., Belleville, Ill.

FURNITURE AND FILES, STEEL

Art Metal Constn. Co., Jamestown, N. Y.
General Fireproofing Co., Youngstown, O.
Van Dorn Iron Works Co., Cleveland, O.

GARBAGE CANS. (See Cans)

GARBAGE DISPOSAL

Balmer Corp., New York.
Bartlett, C. O. & Snow Co., Cleveland, O.
Cummer & Son Co., F. D., Cleveland, O.
Decarie Incinerator Co., Minneapolis, Minn.
Morse-Boulger Destructor Co., New York.
Nye Odorless Crematory Co., Macon, Ga.

GARBAGE TRUCKS AND WAGONS

*Austin Western Road Mchy. Co., Chicago, Ill.
*Heil Co., Milwaukee, Wis.
*International Motor Co., New York.
Autocar Co., Ardmore, Pa.
Federal Motor Truck Co., Detroit, Mich.
Four Wheel Drive Auto Co., Clintonville, Wis.
Holabog & Bro., Geo. H., Jeffersonville, Ind.
Lee Trailer & Body Co., Chicago, Ill.
Service Motor Truck Co., Wabash, Ind.
Tiffin Wagon Co., Tiffin, O.
Watson Products Corp., Canastota, N. Y.
White Co., Cleveland, O.

GAS ENGINES. (See Engines, Gas and Gasoline.)

GAS METERS

*Pittsburgh Meter Co., East Pittsburgh, Pa.
Bailey Meter Co., Cleveland, O.
Builders Iron Foundry, Providence, R. I.
Cleveland Gas Meter Co., Cleveland, O.
General Electric Co., Schenectady, N. Y.

GAS PRODUCERS

Camden Iron Works, Camden, N. J.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa

GASOLINE STORAGE TANKS

*Heil Co., Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
Biggs Boiler Works, Akron, Ohio.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Byers Machine Co., Ravenna, Ohio.
Chicago Bridge & Iron Works, Chicago, Ill.
Scaife & Sons, Wm. B., Oakmont, Pa.
United Iron Works, Kansas City, Mo.
Wayne Tank & Pump Co., Ft. Wayne, Ind.

GATES, SLUICE

*Ludlow Valve Mfg. Co., Troy, N. Y.
Chapman Valve Mfg. Co., Indian Orchard, Mass
Coffin Valve Co., Boston, Mass.
Coldwell-Wilcox Co., Newburgh, N. Y.
Hardesty Mfg. Co., R., Denver, Col.

GAUGES, RECORDING, PRESSURE, STEAM

Ashcroft Mfg. Co., Bridgeport, Conn.
Bristol Co., Waterbury, Conn.
Crosby Steam Gauge & Valve Co., Boston, Mass
Marsh & Co., Jas. P., Chicago, Ill.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.
U. S. Gauge Co., New York

GAUGES, WATER

Bristol Co., Waterbury, Conn.
Lunkenheimer Co., Cincinnati, O.
United States Gauge Co., New York.
Walworth Mfg. Co., Boston, Mass.

GAUGES, SURFACE, RESERVOIR AND SPECIAL WATER-WORKS

*Clark Co., H. W., Matteon, Ill.
Builders Iron Foundry, Providence, R. I.
Simplex Valve & Meter Co., Philadelphia, Pa.

GLASS, FIREPROOF. (See Wire Glass.)

GRADERS, ROAD (See "Road Graders")

GRADER BLADES

*Adams & Co., J. D., Indianapolis, Ind.
Shunk Mfg. Co., Bucyrus, Ohio.

GRAND STANDS, PORTABLE

Leavitt Mfg. Co., Urbana, Ill.
Wayne Iron Wks., Philadelphia, Pa.

GRINDERS AND SAND RAMMERS

Chicago Pneumatic Tool Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, Ohio.
Ingersoll-Rand Co., New York, N. Y.

GYPSUM PRODUCTS

U. S. Gypsum Co., Chicago, Ill.

HAMMER DRILLS

(See Drills, Hammer.)

** Indicates that the manufacturer carries an advertisement. See index facing inside back cover.*

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DUNN

ROAD FINISHERS
On Concrete Roads in Michigan and Elsewhere

have produced astonishing results;

—made real money for the contractor;

—finished concrete that straight-edged to exacting inspection;

—compacted the concrete into a dense, thoroughly compacted mass, free from voids and air pockets;

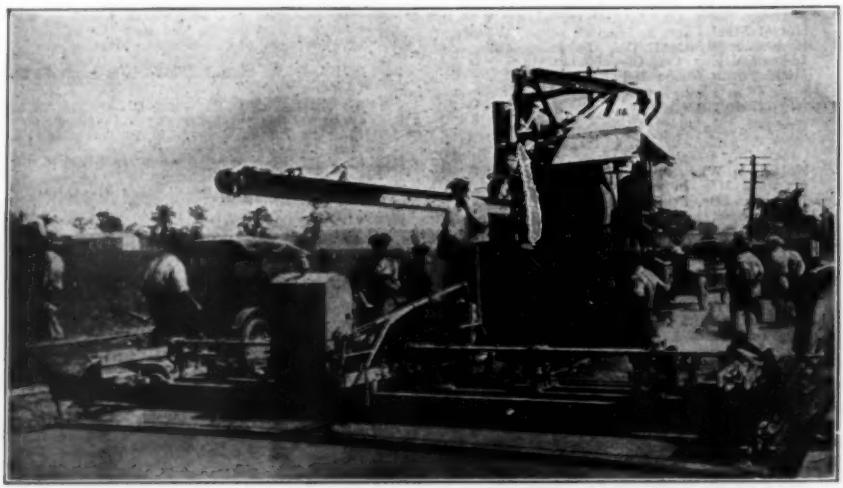
—handled all the concrete turned out by the big 21E Pavers and could have handled more;

—demonstrated their ability to take care of dry mixes just as easily as wet ones.

Dunn agents throughout the country are at your service to demonstrate how Dunn Road 'Finishers will handle YOUR job quickly and economically.

The Dunn Road Machinery Company
Conneaut, Ohio

Send for Finisher Bulletin F-1



HAMMERS, STEAM, PILE. (See Pile Hammers, Steam)

HEAT INSULATING MATERIAL

*Carey Co., Philip, Cincinnati, Ohio.
Johns-Manville, Inc., New York.

HEATERS AND DISTRIBUTORS, TAR AND ASPHALT HEATING KETTLES

*Kinney Mfg. Co., Boston, Mass.

HEATING KETTLES. (See Kettles)

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*Pawling & Harnischfeger Co., Milwaukee, Wis.
American Hoist & Derrick Co., St. Paul, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Lidgerwood Mfg. Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Mundy Hoisting Engine Co., J. S., Newark, N. J.
Street Bros. Mach. Wks., Chattanooga, Tenn.
Weller Mfg. Co., Chicago, Ill.

HOISTS, CONCRETE, TOWER

*Ransome Concrete Mchy. Co., Dunellen, N. J.
Insley Mfg. Co., Indianapolis, Ind.
Lakewood Engineering Co., Cleveland, O.
Mead-Morrison Mfg. Co., E. Boston, Mass.

HOISTS, ELECTRIC

*Pawling & Harnischfeger Co., Milwaukee, Wis.
American Hoist & Derrick Co., St. Paul, Minn.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Clyde Iron Works Sales Co., Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Flory Mfg. Co., S., Bangor, Pa.
Lidgerwood Mfg. Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Mundy Hoisting Eng. Co., J. S., Newark, N. J.
National Hoisting Engine Co., Harrison, N. J.
Street Bros. Mach. Wks., Chattanooga, Tenn.
Treadwell Eng. Co., Easton, Pa.

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*American Cement Mchy. Co., Inc., Keokuk, Ia.
*Austin Machinery Corp'n, Toledo, O.
*Domestic Engine & Pump Co., Shippensburg, Pa.
*Pawling & Harnischfeger Co., Milwaukee, Wis.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Buffalo Hoist & Derrick Co., Buffalo, N. Y.
Clyde Iron Works Sales Co., Duluth, Minn.
Construction Machy. Co., Waterloo, Iowa.
Flory Mfg. Co., S., Bangor, Pa.
Lansing Co., Lansing, Mich.
Lidgerwood Mfg. Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Monighan Machine Co., Chicago, Ill.
Mundy Hoisting Engine Co., J. S., Newark, N. J.
National Hoisting Engine Co., Harrison, N. J.
Novo Engine Co., Lansing, Mich.
O. K. Clutch & Mach. Co., Columbia, Pa.
Orr & Sembower, Reading, Pa.
Schramm, Inc., West Chester, Pa.
Street Bros. Mach. Wks., Chattanooga, Tenn.

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*Denver Rock Drill Mfg. Co., Denver, Colo.
Chicago Pneumatic Tool Co., New York.
Detroit Hoist & Machine Co., Detroit, Mich.
Hanna Eng. Works, Chicago, Ill.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Northern Engineering Works, Detroit, Mich.
Sullivan Mach'y Co., Chicago, Ill.
Worthington Pump & Mchy. Corp., New York.

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*Denver Rock Drill Mfg. Co., Denver, Colo.
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Byers Machine Co., Ravenna, Ohio.
Clyde Iron Works Sales Co., Duluth, Minn.
Flory Mfg. Co., S., Bangor, Pa.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Ingersoll-Rand Co., New York.
Insley Mfg. Co., Indianapolis, Ind.
Lidgerwood Mfg. Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Mundy Hoisting Eng. Co., J. S., Newark, N. J.
National Hoisting Engine Co., Harrison, N. J.
Orr & Sembower, Reading, Pa.
Treadwell Eng. Co., Easton, Pa.

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*Heil Co., The Milwaukee, Wis.
*Wood Hydr. Hoist & Body Co., Detroit, Mich.
Horizontal Hydr. Hoist Co., Detroit, Mich.
Perfection Hoist & Engine Co., Two Rivers, Wis.
Van Dorn Iron Wks., Cleveland, O.

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Dee Co., Wm. E., Chicago, Ill.
Delaware Clay Products Co., Pittsburgh, Pa.
Dickey Clay Mfg. Co., W. S., Kansas City, Mo.
Medal Paving Brick Co., Cleveland, Ohio.
Metropolitan Paving Brick Co., Canton, Ohio.
National Fireproofing Co., Pittsburgh, Pa.

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*Ransome Concrete Mchy. Co., Dunellen, N. J.
Insley Mfg. Co., Indianapolis, Ind.
Lakewood Engineering Co., Cleveland, O.
Weller Mfg. Co., Chicago, Ill.

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Cincinnati Rubber Mfg. Co., Cincinnati, O.
Goodyear Tire & Rubber Co., Akron, O.
Ingersoll-Rand Co., New York.
Penna Flexible Metallic Tubing Co., Phila., Pa.
Republic Rubber Co., Youngstown, O.
U. S. Rubber Co., New York

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*Goodrich Rubber Co., B. F., Akron, O.
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Fabric Fire Hose Co., New York.
Goodyear Tire & Rubber Co., Akron, Ohio.
U. S. Rubber Co., New York.

HOUSE NUMBERS

Hamilton Metal Prod. Co., Hamilton, O.
Niagara Metal Stamping Corp., Nia. Falls, N. Y.

HOUSES, PORTABLE. (See Buildings, Portable)

HYDRANTS, FIRE

*Ludlow Valve Mfg. Co., Troy, N. Y.
*Rensselaer Valve Co., Troy, N. Y.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Columbian Iron Works, Chattanooga, Tenn.
Darling Valve & Mfg. Co., Williamsport, Pa.
Eddy Valve Mfg. Co., Waterford, N. Y.
Iowa Valve Co., Oskaloosa, Ia.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Norwood Engineering Co., Florence, Mass.
Smith Mfg. Co., A. P., East Orange, N. J.
Wood & Co., R. D., Philadelphia, Pa.

HYDRAULIC RAMS

Deming Co., Salem, O.
Rice Hydraulic Engine Co., New York
Seattle Machine Works, Seattle, Wash.

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Brunswick-Kroeschell Co., New Brunswick, N. J.
Carbondale Machine Co., Carbondale, Pa.
Frick Co., Inc., Waynesboro, Pa.
Triumph Ice Machine Co., Cincinnati, O.
Vilter Mfg. Co., Milwaukee, Wis.
Vogt Mach. Co., Henry, Louisville, Ky.
York Mfg. Co., York, Pa.

INCINERATORS, GARBAGE. (See Garbage Disposal)

INDICATOR POSTS. (See Valves)

INSPECTING LABORATORIES

*Conard & Busby, Burlington, N. J.
*Standard Testing Laboratories, Inc., New York.
Allentown Testing Laboratories, Allentown, Pa.
Gulick-Henderson Co., New York
Hunt & Co., Robert W., Chicago, Ill.
N. Y. Testing Laboratories, New York.
Pittsburgh Testing Laboratories, Pittsburgh, Pa.

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Ainsworth & Sons, Wm., Denver, Col.
Berger & Sons, C. L., Boston, Mass.
Brandis & Sons Mfg. Co., Brooklyn, N. Y.

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PORTABLE

TAR AND ASPHALT HEATERS

Style No. 69

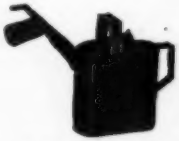
This equipment is built expressly for road and street construction work and is giving complete satisfaction to contractors wherever used. The durable construction found in the Littleford Line has given it the reputation of dependable service.

Style No. 48

Littleford Tar and Asphalt Heaters are made in various styles and different capacities and are suitable for all kinds of road and street construction work.

Complete Catalogue on Request

PAVING TOOLS



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GRAVEL DRYERS

Prompt Shipments from Stock

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500 East Pearl Street

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Kolesch & Co., New York.
Lietz Co., A., San Francisco, Cal.
Leupold & Voelpel, Portland, Ore.
Pfister, Wm. H., Cincinnati, O.
Ulmer, J. C., Co., Cleveland, Ohio.
Weber & Co., F., Philadelphia, Pa.
White Co., David, Milwaukee, Wis.
Wissler Instrument Co., St. Louis, Mo.

IRON WORK, STRUCTURAL AND ORNAMENTAL
(See Bridges and Buildings)

JACKS, LIFTING
*McKiernan-Terry Drill Co., New York.
Buda Company, Chicago, Ill.
Duff Mfg. Co., Pittsburgh, Pa.
Joyce-Cridland Co., Dayton, O.
Kalamazoo Railway Supply Co., Kalamazoo, Mich
Norton, Inc., A. O., Boston, Mass.
Rees Mfg. Co., Pittsburgh, Pa.
Watson-Stillman Company, New York.

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*Clark Co., H. W., Mattoon, Ill.
Duff Mfg. Co., Pittsburgh, Pa.

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Barnum Iron Works, E. T., Detroit, Mich.
Pauly Jail Bldg. Co., St. Louis, Mo.
Stewart Iron Works Co., Cincinnati, Ohio.
Van Dorn Iron Works Co., Cleveland, O.

JOINTS, EXPANSION PAVING
(See Expansion Joint Material)

JOINTS, FLEXIBLE PIPE. (See Flexible Joints.)

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*Barber Asphalt Co., Philadelphia, Pa.
*Connery & Co., Inc., Philadelphia, Pa.
*Good Roads Machinery Co., Kennett Square, Pa.
*Kinney Mfg. Co., Boston, Mass.
*Littleford Bros., Cincinnati, O.
*Universal Road Machinery Co., Kingston, N. Y.
Acme Road Mach. Co., Frankfort, N. Y.
Hauck Mfg. Co., Brooklyn, N. Y.
Honhorst Co., Jos., Cincinnati, Ohio.
Macleod Co., Cincinnati, O.
Stuebner Iron Wks., G. L., L. I. City, N. Y.
Tarrant Mfg. Co., Saratoga Springs, N. Y.
Union Iron Wks., Hoboken, N. J.

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Adams & Westlake Co., Chicago, Ill.
Defiance Lantern & Stamping Co., Rochester, N.Y.
Dietz Co., R. E., New York.
Handlan, Buck Mfg. Co., St. Louis, Mo.

LATH, METAL
*Servicised Products Co., Chicago, Ill.
*Truscon Steel Co., Youngstown, O.
Berger Mfg. Co., Canton, O.
Bostwick Steel Lath Co., Niles, O.
Consol. Expanded Metal Co., Braddock, Pa.
Corrugated Bar Co., Inc., Buffalo, N. Y.
General Fireproofing Co., Youngstown, O.
Milwaukee Corrugating Co., Milwaukee, Wis.
Northwestern Expanded Metal Co., Chicago, Ill.
Penn Metal Co., Boston, Mass.
Sykes Metal Lath & Roofing Co., Niles, O.
Wickwire Spencer Steel Corp., New York.
Youngstown Pressed Steel Co., Warren, O.

LAWN MOWERS
Coldwell Lawn Mower Co., Newburgh, N. Y.
Gilson Mfg. Co., Port Washington, Wis.
Ideal Power Lawn Mower Co., Lansing, Mich.
Jacobsen Mfg. Co., Racine, Wis.
Penna. Lawn Mower Works, Philadelphia, Pa
Philadelphia Lawn Mower Co., Philadelphia, Pa.
Townsend Co., S. P., Bloomfield, N. J.
Worthington Mower Co., Shawnee, Pa.

LEADITE
Leadite Co., The, Philadelphia, Pa.

LEAD-MELTING FURNACES
*Littleford Bros., Cincinnati, O.
Canton Fdry & Machy. Co., Canton, O.
Chicago Flexible Shaft Co., Chicago, Ill.
Fochs Sons, Geo., Hoboken, N. J.
Hauck Mfg. Co., Brooklyn, N. Y.
Smith Mfg. Co., A. P., E. Orange, N. J.

LETTERS AND FIGURES, METAL
Niagara Metal Stamp. Corp., Niagara Falls, N. Y

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Carbic Mfg. Co., Duluth, Minn.
General Electric Co., Schenectady, N. Y.
Hauck Mfg. Co., Brooklyn, N. Y.
Macleod Co., Cincinnati, O.
Milburn Co., Alex., Baltimore, Md.
Prest-O-Lite Co., Inc., New York

LIGHTING STANDARDS. (See Street Lamp Posts)

LIQUID CHLORINE
Electro Bleaching Gas Co., New York.
Mathieson Alkali Works, Inc., New York.
Penna. Salt Mfg. Co., Philadelphia, Pa.

LOADERS, GRAVEL, WAGON, CAR, ETC.
*Atlas Engineering Co., Milwaukee, Wis.
*Austin Machinery Corp'n, Toledo, O.
*Haiss Mfg. Co., Geo., New York.
*Sauerman Bros., Chicago, Ill.
*Smith Co., T. L., Milwaukee, Wis.
*Universal Road Machinery Co., Kingston, N. Y.
Bacon Co., Edw. R., San Francisco, Cal.
Barber-Greene Co., Aurora, Ill.
Bay City Dredge Works, Bay City, Mich.
Bonney Supply Co., Inc., Rochester, N. Y.
Chain Belt Co., Milwaukee, Wis.
Economy Excavator Co., Iowa Falls, Iowa.
Fairfield Engineering Co., Lancaster, Ohio.
Gifford-Wood Co., Hudson, N. Y.
Jeffrey Mfg. Co., Columbus, O.
Lee Trailer & Body Co., Chicago, Ill.
Link-Belt Co., Chicago, Ill.
Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn
Nelson Iron Wks., Brooklyn, N. Y.
Portable Machy. Co., Passaic, N. J.
Sackett Screen & Chute Co., H. B., Chicago, Ill
Weller Mfg. Co., Chicago, Ill.

LOCK BAR STEEL PIPE
East Jersey Pipe Co., New York.

LOCKERS, STEEL
Durand Steel Locker Co., Chicago, Ill.
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Medart Mfg. Co., Fred., St. Louis, Mo.

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American Locomotive Co., New York, N. Y
Baldwin Locomotive Works, The, Phila., Pa.
Brookville Track & Tractor Co., Brookville, Pa
Burton Eng. & Mach. Co., Cincinnati, O.
Davenport Locomotive Works, Davenport, Ia.
Fate-Root-Heath Co., Plymouth, O.
Hadfield-Penfield Steel Co., Bucyrus, O.
Lima Locomotive Wks., Lima, O.
Industrial Equipment Co., Inc., Minster, O.
Milwaukee Locomotive Mfg. Co., Milwaukee, Wis
Porter Co., H. K., Pittsburgh, Pa.
Vulcan Iron Works, Wilkes-Barre, Pa.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa
Whitcomb Co., Geo. D., Rochelle, Ill.

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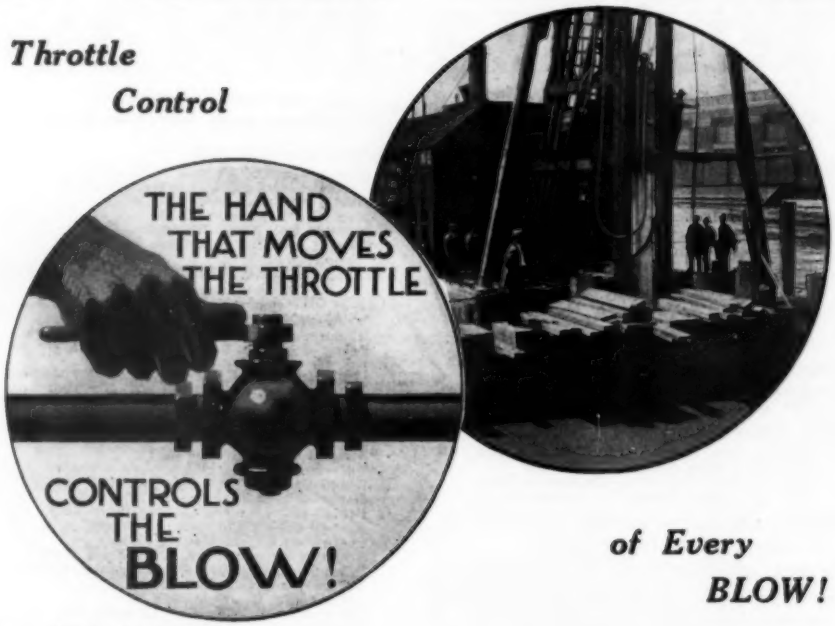
Brown Co., Portland, Me.
Crowell & Spencer Lumber Co., Long Leaf, La.
Exchange Sawmills Sales Co., Kansas City, Mo.
Great Southern Lumber Co., Bogalusa, La.
Industrial Lumber Co., Elizabeth, La.
Long Bell Lumber Co., Kansas City, Mo.
Sargent Lumber Co., Little Rock, Ark
Sterner Co., Inc., E. J., New York
Weyerhaeuser Sales Co., Spokane, Wash.

LUMBER, STEEL
*Truscon Steel Co., Detroit, Mich.
Berger Mfg. Co., Canton, O.

For Concrete Pile Driving

Throttle Control



of Every BLOW!

You get it with

McKiernan-Terry Hammers

9-B and 11-B Double Acting

At last it is possible to use heavy pile hammers to drive concrete piles—or heavy timber piles—when prevailing conditions seem to indicate loading and jetting as the only method possible.

The throttle control of the blows of McKiernan-Terry 9-B and 11-B concrete Pile driving Hammers permits exact regulation of the velocity, energy and frequency of the blows!

The fact is, the throttle control made possible by these Hammers permits exact regulation of the blow for any size and type of concrete pile and soil resistance.

A touch of the operator's hand on the throttle, and the steam accelerated ram of these big hammers can be made to merely tap-tap on the pile head.

—or to deliver from 120 to 140 blows a minute using the entire force of the 1250 lb. and 3625 lb. rams.

Think this over. Your experience will tell you that throttle control of velocity, energy and frequency of ram blows is essential to meet varying conditions of driving concrete piles and heavy timber piling.

In McKiernan-Terry Double Acting pile hammers you get throttle control of every blow. Write for Bulletin 31 fully descriptive of these hammers.

McKIERNAN-TERRY DRILL COMPANY

Rock Drills **Pile Hammers** **Lifting Jacks** **Mining and Quarrying Machinery**

19 PARK ROW, NEW YORK **Works at Dover, N. J.**

Agencies in the Following Cities:

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National Pressed Steel Co., Massillon, O.
Northwestern Exp. Metal Co., Chicago, Ill.

METAL LATH. (See "Lath")

METAL ROOFING (See "Roofing")

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*Clark Co., H. W., Matteson, Ill.
*Ford Meter Box Co., Wabash, Ind.
Clow & Sons, J. B., Chicago, Ill.
Columbian Iron Works, Chattanooga, Tenn.
Mueller Mfg. Co., H., Decatur, Ill.

METER COUPLINGS

*Clark Co., H. W., Matteson, Ill.
*Ford Meter Box Co., Wabash, Ind.
*Neptune Meter Co., New York.
*Pittsburgh Meter Co., E. Pittsburgh, Pa.
*Union Water Meter Co., Worcester, Mass.
Mueller Mfg. Co., H., Decatur, Ill.

METER TESTERS

*Clark Co., H. W., Matteson, Ill.
*Ford Meter Box Co., Wabash, Ind.
*Neptune Meter Co., New York.
*Pittsburgh Meter Co., E. Pittsburgh, Pa.
Buffalo Meter Co., Buffalo, N. Y.
Mueller Mfg. Co., H., Decatur, Ill.
National Meter Co., New York.

METERS, ELECTRIC (WATTHOUR)

Duncan Elec. Mfg. Co., LaFayette, Ind.
General Electric Co., Schenectady, N. Y.
Sangamo Electric Co., Springfield, Ill.
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

METERS, GAS

*Pittsburgh Meter Co., E. Pittsburgh, Pa.
American Meter Co., New York
Builders Iron Fdry., Providence, R. I.

METERS, WATER

*Badger Meter Mfg. Co., Milwaukee, Wis.
*Neptune Meter Co., New York.
*Pittsburgh Meter Co., E. Pittsburgh, Pa.
*Union Water Meter Co., Worcester, Mass.
Buffalo Meter Co., Buffalo, N. Y.
Federal Meter Co., Brooklyn, N. Y.
Gamon Meter Co., Newark, N. J.
Hersey Mfg. Co., Boston, Mass.
National Meter Co., New York.
Thomson Meter Co., Brooklyn, N. Y.
Worthington Pump & Mchy. Corp., New York.

METERS, WATER (VENTURI TYPE)

Builders Iron Foundry, Providence, R. I.
Simplex Valve & Meter Co., Philadelphia, Pa.

MIXERS, CONCRETE. (See Concrete Mixers.)

MIXERS, GROUT

*American Cement Mchy. Co., Inc., Keokuk, Ia.
Kent Machine Co., Kent, O.
Lakewood Engineering Co., Cleveland, O.
Union Iron Works, Inc., Hoboken, N. J.

MIXERS, HOT

*Austin Machinery Corp'n, Toledo, O.
*Barber Asphalt Co., Philadelphia, Pa.
*Koehring Co., Milwaukee, Wis.
Kent Machine Co., Kent, O.

MIXERS, MORTAR

*American Cement Mchy. Co., Inc., Keokuk, Ia.
*Austin Machinery Corp'n, Toledo, O.
*Ransome Concrete Mchy. Co., Dunellen, N. J.
*Smith Co., T. L., Milwaukee, Wis.
Blaw-Knox Co., Pittsburgh, Pa.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Construction Machinery Co., Waterloo, Ia.
Kent Machine Co., Kent, O.
Knickerbocker Co., Jackson, Mich.
Lansing Co., Lansing, Mich.
Lakewood Engineering Co., Cleveland, Ohio.
Marsh-Capron Co., Chicago, Ill.

MOTORCYCLES

Ace Motor Corp., Philadelphia, Pa.
Cleveland Motorcycle Co., Cleveland, Ohio.
Excelsior Motor Mfg. & Supply Co., Chicago, Ill.
Harley-Davidson Motor Co., Milwaukee, Wis.
Hendee Mfg. Co., Springfield, Mass.

MOTORS, ELECTRIC

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Crocker-Wheeler Co., Ampere, N. J.
Cutler-Hammer Mfg. Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Holtzer-Cabot Elec. Co., Boston, Mass.
Lincoln Elec. Co., Cleveland, O.
Robbins & Myers Co., Springfield, O.
Wagner Elec. Mfg. Co., St. Louis, Mo.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

MOTORS, GASOLINE

Buda Co., Harvey, Ill.
Continental Motors Corp., Detroit, Mich.
Herschell-Spillman Co., No. Tonawanda, N. Y.
Hinkley Motors, Inc., Detroit, Mich.
Waukesha Motor Co., Waukesha, Wis.
Wisconsin Motor Mfg. Co., Milwaukee, Wis.

MOTOR TRUCKS

*Garford Motor Truck Co., Lima, O.
*General Motors Truck Co., Pontiac, Mich.
*International Motor Co., New York.
Acme Motor Truck Co., Cadillac, Mich.
Atterbury Motor Car Co., Buffalo, N. Y.
Autocar Co., Ardmore, Pa.
Bessemer Motor Truck Co., Grove City, Pa.
Brockway Motor Truck Co., Cortland, N. Y.
Clydesdale Motor Truck Co., Clyde, O.
Corbitt Motor Truck Co., Henderson, No. Car.
Denby Motor Truck Co., Detroit, Mich
Diamond T. Motor Car Co., Chicago, Ill.
Duplex Truck Co., Lansing, Mich.
Federal Motor Truck Co., Detroit, Mich.
Four Wheel Drive Auto Co., Clintonville, Wis.
Gramm Bernstein Motor Truck Co., Lima, O.
Indiana Truck Corp'n., Marion, Ind.
International Harvester Co., Chicago, Ill.
Kelly Springfield Motor Truck Co., Springfield, O.
Kissel Motor Car Co., Hartford, Wis.
Larrabee-Deyo Motor Tr. Co., Binghamton, N.Y.
Nash Motors Co., Kenosha, Wis.
Oshkosh Truck Sales & Finance Corp., Oshkosh, Wis.
Packard Motor Car Co., Detroit, Mich.
Pierce Arrow Motor Car Co., Buffalo, N. Y.
Republic Motor Truck Co., Alma, Mich.
Rowe Motor Mfg. Co., Lancaster, Pa.
Service Motor Truck Co., Wabash, Ind.
Sterling Motor Truck Co., Milwaukee, Wis.
Stewart Motor Corp'n., Buffalo, N. Y.
Tiffin Wagon Co., Tiffin, O.
Titan Motor Truck Co., Milwaukee, Wis.
Traffic Motor Truck Co., St. Louis, Mo.
Transport Truck Co., Mt. Pleasant, Mich.
U. S. Motor Truck Co., Cincinnati, O.
Ward LaFrance Truck Co., Elmira, N. Y.
Wilson Co., J. C., Detroit, Mich.
White Co., Cleveland, Ohio.

MOULDS, CONCRETE

Blaw-Knox Co., Pittsburgh, Pa.
Hydraulic Steelcraft Co., Cleveland, O.

NUMBERS, HOUSE (See "House Numbers")

OAKUM

Wall Rope Works, Beverly, N J.

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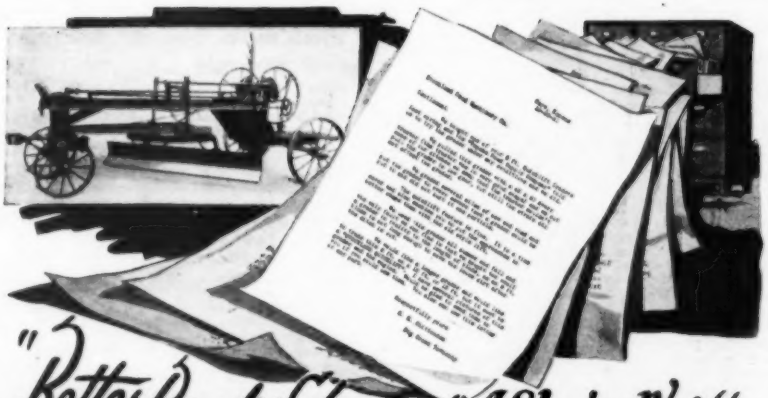
*Barber Asphalt Co., Philadelphia, Pa.
*Pioneer Asphalt Co., Lawrenceville, Ill.
*Standard Oil Co. (Indiana), Chicago, Ill.
*Texas Company, New York.
Atlantic Refining & Asphalt Corp'n, Philadelphia
Barrett Co., New York.
Headley Good Roads Co., Philadelphia, Pa.
Pierce Oil Corp., New York.
Sinclair Refining Co., Chicago, Ill.
Standard Oil Co., (La.) New Orleans, La.
Standard Oil Co., (N. J.) Newark, N. J.
U. S. Asphalt Refining Co., New York.



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From every corner of the country come letters like these - - vigorous, hearty, spontaneous acclaim for the machine that does *more than is expected of it.*

These Stockland owners (and thousands like them) know what it means to have a finely designed, skillfully constructed, ***over-strength*** road grader ***save them money*** while doing high grade road work.

Is ***your*** letter among the many in our files? If not, just reflect — it is Stockland Performance that inspires such heaping satisfaction. In one state out of the 42 where Stocklands are extensively used there are over a thousand machines in service.

It will pay you to know more about Stockland Quicklift Graders—write for 1923 literature today.

STOCKLAND GRADERS HAVE EASY OPERATING CONTROL

Ease and flexibility of operation is an outstanding Stockland advantage. Yet the Stockland design does not favor this advantage at the expense of earth-moving capacity, or power economy.

The Stockland, like most simple, practical things, has been painstakingly developed. Thus the control is centered at the operator's platform.

Hand wheels are of proper size to give adequate leverage. They turn comfortably — no close corners to bark knuckles and fingers. All levers are self-locking and cannot lose hold unless deliberately released.

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This means better work, and greater comfort for the operator. It means prompt mechanical response to the operator's slightest wish, all to the end of making "better roads cheaper."

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Cook Paint & Varnish Co., Kansas City, Mo.
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Barrett Co., New York.
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Hydrex Asphalt Products Corp., New York.
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Bausman Mfg. Co., Bausman, Pa.
Dow Co., Louisville, Ky.
Mott Iron Wks., J. L., New York.
Stewart Iron Works, Cincinnati, Ohio.

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Jennison-Wright Co., Toledo, O.
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Wyckoff Pipe & Creosoting Co., New York.

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Barr Clay Co., Streator, Ill.
Binghamton Brick Co., Binghamton, N. Y.
Burton Townsend Co., Zanesville, O.
Cleveland Brick & Clay Co., Cleveland, O.
Clydesdale Brick & Stone Co., Pittsburgh, Pa.
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Corry Brick & Tile Co., Corry, Pa.
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Georgia Brick & Tile Co., Adairsville, Ga.
Hammond Fire Brick Co., Fairmont, W. Va.
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McAvoy Vit. Brick Co., Philadelphia, Pa.
Mack Mfg. Co., Wheeling, W. Va.
Mayer Brick Co., C. P., Bridgeville, Pa.
Medal Paving Brick Co., Cleveland, O.
Metropolitan Paving Brick Co., Canton, O.
Moberly Paving Brick Co., Moberly, Mo.
Murphysboro Paving Brick Co., Murphysboro, Ill.
Patton Clay Mfg. Co., Patton, Pa.
Peebles Brick Co., Portsmouth, O.
Penna. Clay Co., Pittsburgh, Pa.
Pittsburgh Paving Brick Co., Pittsburgh, Kas.
Poston Paving Brick Co., Crawfordsville, Ind.
Purington Paving Brick Co., Galesburg, Ill.
Southern Clay Mfg. Co., Chattanooga, Tenn.
Springfield Paving Brick Co., Springfield, Ill.
Sterling Brick Co., Olean, N. Y.
Streator Clay Mfg. Co., Streator, Ill.
Thornton Fire Brick Co., Clarksburg, W. Va.
Thurber Brick Co., Thurber, Texas.
Veedersburg Paver Co., Veedersburg, Ind.
Western Clay Mfg. Co., Helena, Mont.
Westport Paving Brick Co., Westport, Md.

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PAVING GUARDS, STEEL
Godwin Co., W. S., Baltimore, Md.
International Steel Tie Co., Cleveand, O.

PAVING MATERIALS (See "Asphalt," "Paving Brick," "Granite Block," etc.)

PAVING MIXERS. (See Concrete Mixers)

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McMyler Interstate Co., Cleveland, O.
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Bethlehem Steel Co., Bethlehem, Pa.
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Jones & Laughlin Steel Co., Pittsburgh, Pa.

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*U. S. Cast Iron Pipe & Fdy. Co., Burlington, N.J
American Cast Iron Pipe Co., Birmingham, Ala.
Clow & Sons, J. B., Chicago, Ill.
Donaldson Iron Co., Emaus, Pa.
Fox & Co., John, New York.
Glamorgan Pipe & Fdry. Co., Lynchburg, Va.
Lynchburg Foundry Co., Lynchburg, Va.
National Cast Iron Pipe Co., Birmingham, Ala.
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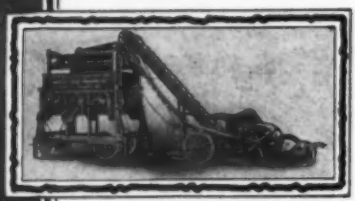

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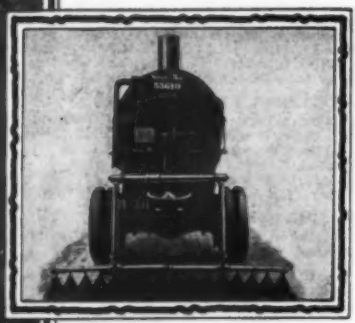

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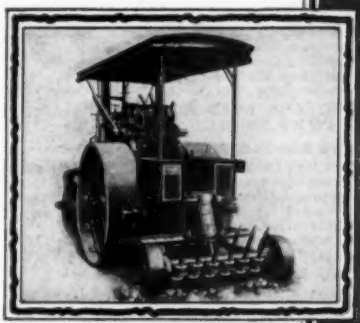

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Canton Culvert & Silo Co., Canton, O.
Chattn. Boiler & Tank Co., Chattanooga, Tenn.
Chicago Bridge & Iron Works, Chicago, Ill.
East Jersey Pipe Co., New York.
Hammond Iron Works, Warren, Pa.
Hardesty Mfg. Co., R., Denver, Col.
Honhorst Co., Jos., Cincinnati, Ohio.
Lancaster Iron Works, Lancaster, Pa.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Tippet & Wood, Phillipsburg, N. J.
Welter Mfg. Co., Chicago, Ill.

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Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.

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Jones & Laughlin Steel Co., Pittsburgh, Pa.
National Tube Co., Pittsburgh, Pa.
Republic Iron & Steel Co., Youngstown, O.
Steel & Tube Co. of Am., Chicago, Ill.
Youngstown Sheet & Tube Co., Youngstown, O.

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American Wood Pipe Co., Tacoma, Wash.
Continental Pipe Mfg. Co., Seattle, Wash.
Michigan Pipe Co., Bay City, Mich.
Pacific Tank & Pipe Co., San Francisco, Cal.
Redwood Mfrs. Co., San Francisco, Cal.
Standard Wood Pipe Co., Williamsport, Pa.
Wyckoff & Sons Co., A., Elmira, N. Y.

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*U. S. Cast Iron Pipe & Fdry. Co., Burlington, N. J.
American C. I. Pipe Co., Birmingham, Ala.
Builders Iron Fdry, Providence, R. I.
Clow & Sons, J. B., Chicago, Ill.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
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Warren Fdry. & Mach. Co., New York.
Wood & Co., R. D., Philadelphia, Pa.

PIPE HANDLING MACHINERY

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Tayler Portable Steel Derrick Co., Chicago, Ill.

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*Russell Grader Mfg. Co., Minneapolis, Minn.
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International Harvester Co., Chicago, Ill.
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Oliver Chilled Plow Works, South Bend, Ind.
Sidney Steel Scraper Co., Sidney, O.
Smith & Sons Mfg. Co., Kansas City, Mo.
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PLUMBING SUPPLIES

Clow & Sons, J. B., Chicago, Ill.
Crane Co., Chicago, Ill.
Glauber Brass Mfg. Co., Cleveland, O.
Mott Iron Wks., J. L., New York
Mueller Mfg. Co., H., Decatur, Ill.
Rundle-Spence Mfg. Co., Milwaukee, Wis.
United Brass Mfg. Co., Cleveland, O.
Walworth Mfg. Co., Boston, Mass.

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Blaw-Knox Co., Pittsburgh, Pa.
Electric Railway Equipment Co., Cincinnati, O.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.

PORTABLE BUILDINGS

*Littleford Bros., Cincinnati, Ohio.
*Truscon Steel Co., Youngstown, O.
Blaw-Knox Co., Pittsburgh, Pa.
Milwaukee Corrugating Co., Milwaukee, Wis.
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PORTLAND CEMENT. **(See Cement.)**

POWDER. **(See Explosives.)**

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Sullivan Machinery Co., Chicago, Ill.

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American Steam Pump Co., Battle Creek, Mich.
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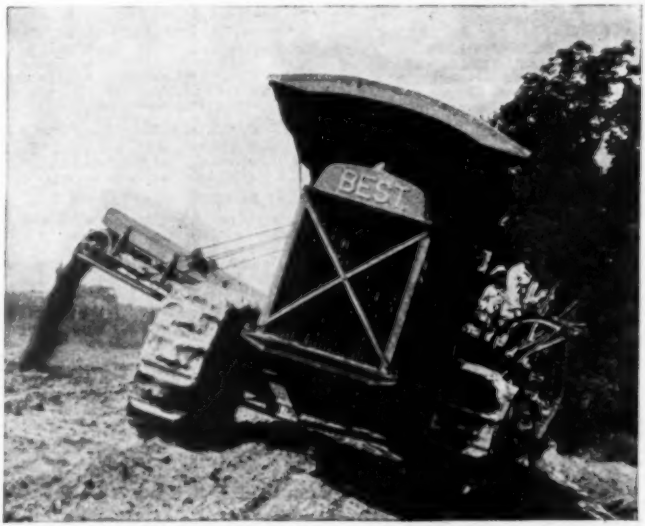
Bethlehem Steel Co., Bethlehem, Pa.
Buffalo Steam Pump Co., Buffalo, N. Y.
Cameron Steam Pump Works, A. S., New York.
Dayton-Dowd Co., Quincy, Ill.
Dean Bros. Steam Pump Wks., Indianapolis, Ind.
De Laval Steam Turbine Co., Trenton, N. J.
Deming Co., Salem, O.
Fairbanks, Morse & Co., Chicago, Ill.
Gardner Governor Co., Quincy, Ill.



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Murray Iron Works Co., Burlington, Ia.
Northern Fire Apparatus Co., Minneapolis, Minn.
Scranton Pump Co., Scranton, Pa.
Union Steam Pump Co., Battle Creek, Mich.
Vogt Bros. Mfg. Co., Louisville, Ky.
Warren Steam Pump Co., Warren, Mass.
Weinman Pump Mfg. Co., Columbus, O.
Yeomans Bros. Co., Chicago, Ill.

PUMPS, CENTRIFUGAL

*Domestic Engine & Pump Co., Shippensburg, Pa.
*Keystone Driller Co., Beaver Falls, Pa.
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American Well Works, Aurora, Ill.
Aurora Pump & Mfg. Co., Aurora, Ill.
Bethlehem Steel Co., Bethlehem, Pa.
Cameron Steam Pump Works, A. S., New York.
Dayton-Dowd Co., Quincy, Ill.
De Laval Steam Turbine Co., Trenton, N. J.
Erie Pump & Engine Works, Medina, N. Y.
Evinrude Motor Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
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Indiana Air Pump Co., Indianapolis, Ind.
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Manistee Iron Wks., Manistee, Mich.
Midwest Engine Co., Indianapolis, Ind.
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United Iron Works, Kansas City, Mo.
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Aurora Pump & Mfg. Co., Aurora, Ill.
Barnes Mfg. Co., Mansfield, O.
Cameron Steam Pump Works, A. S., New York.
Carter Co., Ralph B., New York.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Construction Mach'y Co., Waterloo, Ia.
Dayton-Dowd Co., Quincy, Ill.
Deming Co., Salem, Ohio.
Emerson Pump & Valve Co., Alexandria, Va.
Erie Pump & Engine Works, Medina, N. Y.
Evinrude Motor Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
Goulds Mfg. Co., Seneca Falls, N. Y.
LeCourtenay Co., Newark, N. J.
McGowan Co., J. H., Cincinnati, O.
Midwest Engine Co., Indianapolis, Ind.
Morris Machine Works, Baldwinsville, N. Y.
Myers & Bro. Co., F. E., Ashland, O.
Northern Fire App. Co., Minneapolis, Minn.
Novo Engine Co., Lansing, Mich.
Pulsometer Steam Pump Co., New York.
Schramm, Inc., West Chester, Pa.
Standard Scale & Supply Co., Pittsburgh, Pa.
Van Neuhuys Machine Wks., Albany, N. Y.
Waldo Bros. & Bond Co., Boston, Mass.

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*Clark Co., H. W., Matteon, Ill.
*Domestic Engine & Pump Co., Shippensburg, Pa.
*Keystone Driller Co., Beaver Falls, Pa.
Aldrich Pump Co., Allentown, Pa.
American Well Works, Aurora, Ill.
Cameron Steam Pump Works, A. S., New York.
Cook, Inc., A. D., Lawrenceburg, Ind.
Deming Co., Salem, O.
Fairbanks, Morse & Co., Chicago, Ill.
Goulds Mfg. Co., Seneca Falls, N. Y.
Harris Air Pump Co., Indianapolis, Ind.
Indiana Air Pump Co., Indianapolis, Ind.
Layne & Bowler Co., Memphis, Tenn.
McDonald Mfg. Co., A. Y., Dubuque, Ia.
Midwest Engine Co., Indianapolis, Ind.
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American Well Works, Aurora, Ill.
Aurora Pump & Mfg. Co., Aurora, Ill.
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Cameron Steam Pump Wks., A. S., New York.
Erie Pump & Engine Co., Medina, N. Y.
Morris Machine Works, Baldwinsville, N. Y.
Rumsey Pump Co., Ltd., Seneca Falls, N. Y.
Wood & Co., R. D., Philadelphia, Pa.
Worthington Pump & Mchy. Corp., New York.

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Gilbert & Barker Mfg. Co., Springfield, Mass.
Northern Fire App. Co., Minneapolis, Minn.
Wayne Tank & Pump Co., Fort Wayne, Ind.
Worthington Pump & Mach. Corp., New York.

PUMPS, POWER

*Domestic Engine & Pump Co., Shippensburg, Pa.
*Kinney Mfg. Co., Boston, Mass.
*Koehring Co., Milwaukee, Wis.
Alamo Iron Works, San Antonio, Tex.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Steam Pump Co., Battle Creek, Mich
American Well Works, Aurora, Ill.
Aurora Pump & Mfg. Co., Aurora, Ill.
Barnes Mfg. Co., Mansfield, O.
Dayton-Dowd Co., Quincy, Ill.
De Laval Steam Turbine Co., Trenton, N. J.
Deming Co., Salem, O.
Evinrude Motor Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
Gardner Governor Co., Quincy, Ill.
Goulds Mfg. Co., Seneca Falls, N. Y.
Indiana Air Pump Co., Indianapolis, Ind.
Lawrence Machine Co., Lawrence, Mass.
Lea-Courtenay Co., Newark, N. J.
McGowan Co., J. H., Cincinnati, O.
Myers & Bro. Co., F. E., Ashland, O.
Nordberg Mfg. Co., Milwaukee, Wis.
Northern Fire Aparatus Co., Minneapolis, Minn.
Weinman Pump Mfg. Co., Columbus, O.
Worthington Pump & Machy. Corp., New York.
Yeomans Bros. Co., Chicago, Ill.

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Bethlehem Steel Co., Bethlehem, Pa.
Cambria Steel Co., Philadelphia, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Easton Car & Constn. Co., New York.
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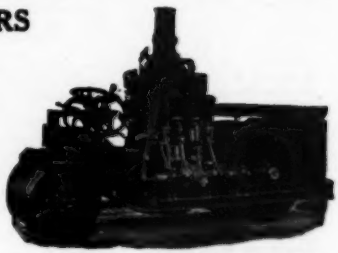

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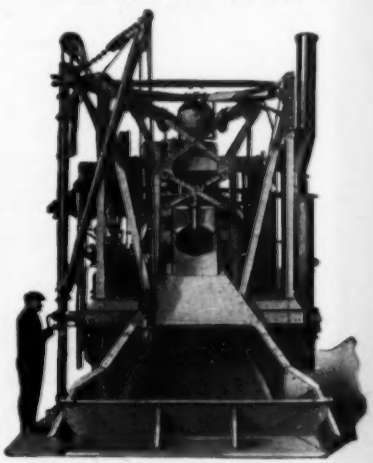

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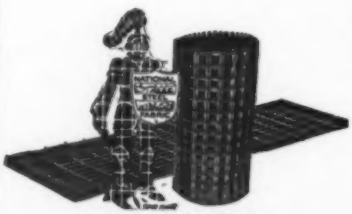

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BF 77	4	7	.074	12	7	.025	35.4
BF 66	4	6	.087	12	6	.029	41.6
BF 55	4	5	.101	12	5	.034	48.4
CF 77	6	7	.049	12	7	.025	27.0
CF 66	6	6	.058	12	6	.029	31.8
CF 55	6	5	.067	12	5	.034	37.0
CF 44	6	4	.080	12	4	.040	43.8
CF 33	6	3	.093	12	3	.047	51.0
CF 00	6	0	.148	12	0	.080	83.3
CC 88	6	8	.041	6	8	.041	30.0
CC 77	6	7	.049	6	7	.049	35.7
CC 66	6	6	.058	6	6	.058	42.0
CC 55	6	5	.067	6	5	.067	48.8
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Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

STREET AND ROAD SIGNS. (See Signs, Street and Road.)

STREET CLEANERS' CARTS

*Rochester Can Co., Rochester, N. Y.
Durlach Can & Iron Works, Brooklyn, N. Y.
Tarrant Mfg. Co., Saratoga Springs, N. Y.

STREET FLUSHERS AND SPRINKLERS

*Austin-Western Road Machy. Co., Chicago, Ill.
*General Motors Truck Co., Pontiac, Mich.
*Heil Co., The, Milwaukee, Wis.
*International Motor Co., New York.
*Municipal Supply Co., South Bend, Ind.
Autocar Co., Ardmore, Pa.
Etnyre & Co., E. D., Oregon, Ill.
Federal Motor Truck Co., Detroit, Mich.
Packard Motor Car Co., Detroit, Mich.
Pierce Arrow Motor Car Co., Buffalo, N. Y.
Tiffin Wagon Co., Tiffin, O.
White Co., Cleveland, O.

STREET LAMP POSTS

Clow & Sons, J. B., Chicago, Ill.
Drake Mfg. Co., Friendship, N. Y.
Electric Railway Equipment Co., Cincinnati, O.
General Electric Co., Schenectady, N. Y.
King Mfg. Co., Chicago, Ill.
Massey Concrete Products Co., Chicago, Ill.
Mott Iron Wks., J. L., New York
Union Metal Mfg. Co., Canton, O.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

STREET SIGNS (See Signs, Street)

STREET SWEEPERS

*Austin-Western Road Mchy. Co., Chicago, Ill.
*Good Roads Mach. Co., Kennett Square, Pa.
*Universal Road Machinery Co., Kingston, N. Y.
Elgin Sales Corp'n, New York.
Springfield Motor Sweeper Co., Springfield, O.

STRUCTURAL STEEL AND IRON. (See Bridges and Buildings)

STUMP PULLERS

Bennett & Co., H. L., Westerville, O.
Clyde Iron Works, Duluth, Minn.
La Plant-Choate Mfg. Co., Cedar Rapids, Ia.
Thomas Elevator Co., Chicago, Ill.

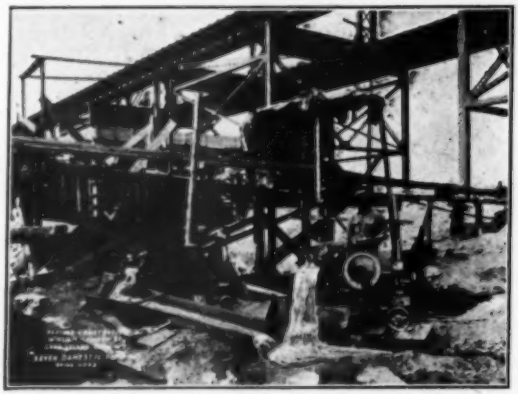
SUPERHEATERS

Babcock & Wilcox Co., New York.
Power Specialty Co., New York.
Superheater Co., New York.

SURVEYORS' INSTRUMENTS. (See Instruments.)

SWITCHBOARDS

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Wagner Elec. Mfg. Co., St. Louis, Mo.
Westinghouse Elec. & Mfg.Co.,E. Pittsburgh, Pa.



"Domestic" Diaphragms on Foundation Work
(Factory Construction Co., New York)

Why Pump By Hand?

Shortage of labor is fast becoming acute and many jobs would be "tied up" but for the use of machines.

The Factory Construction Co., of New York, with SEVEN "Domestic" Trench Pump Units kept all their "footings" free of water. To have done this with hand pumps would have kept from other work at least TWENTY men.

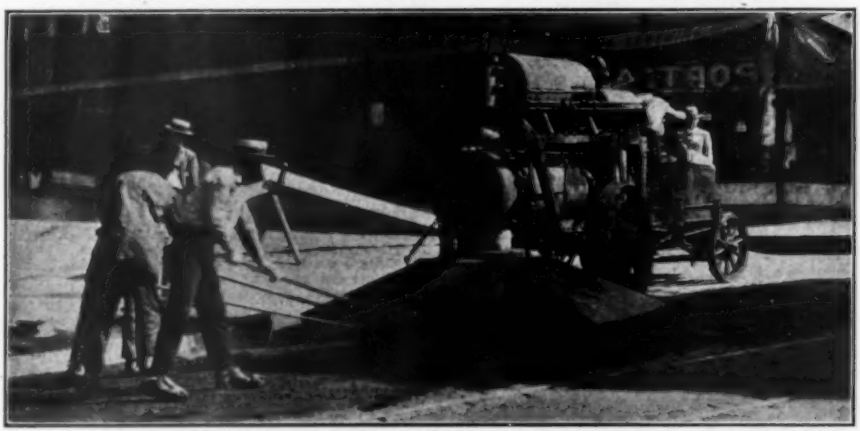
Four "Domestic" Diaphragm Power Pumps on the McLennan Construction Co's job at Belmont and Sheridan Rd., Chicago, released from pump duty at least twelve much needed laborers.

Twenty-nine "Domestic" Power Trench Pumps purchased by the Sewerage & Water Board of New Orleans, not only speeded up to completion that city's wonderful new sewerage system but by keeping the excavations dry permitted hundreds of masons, carpenters and other mechanics to be employed.

"Domestic" Power Trench Pumps are selected by "Knowing" Contractors—let us tell you why. Send for Bulletin "TC".

DOMESTIC ENGINE & PUMP CO.
Shippensburg, Pa., U. S. A.

MAKE BETTER ASPHALT STREET REPAIRS



The Improved Equitable Asphalt Heater Softens 1500 Square Yards a Day

Proper bonding of old and new asphalt is made possible by this fool proof machine which does not require hot water to operate. The heating hood slides on the ground saving time and heat. The machine heats 45 square feet of pavement in 1 to 2 minutes and moves quickly ahead. Send for our new prices and specifications.

THE EQUITABLE ASPHALT MAINTENANCE COMPANY
1901 Campbell Street **Kansas City, Mo.**

TABLES AND BOARDS, DRAWING. (See Drawing Materials.)

TAMPING MACHINES

*Pawling & Harnischfeger Co., Milwaukee, Wis.
Construction Mach'y Co., Waterloo, Ia.
Ingersoll-Rand Co., New York

TANKS, AIR COMPRESSOR

*Connery & Co., Inc., Philadelphia, Pa.
*Heil Co., Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
Abendroth & Root Mfg. Co., New York.
Biggs Boiler Wks., Akron, O.
Graver Corporation, E. Chicago, Ind.
Indiana Air Pump Co., Indianapolis, Ind.
Chicago Bridge & Iron Works, Chicago, Ill.
Ingersoll-Rand Co., New York.
Lancaster Iron Wks., Lancaster, Pa.
National Tube Co., Pittsburgh, Pa.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Scaife & Sons Co., W. B., Pittsburgh, Pa.
Westinghouse Tract. Brake Co., Wilmerding, Pa.
Worthington Pump & Machy. Corp., New York.

TANKS, STEEL

*Connery & Co., Philadelphia, Pa.
*Heil Co., Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
Avery Co., Peoria, Ill.
Biggs Boiler Wks., Akron, O.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Case Threshing Mach. Co., J. I., Racine, Wis.
Caldwell Co., W. E., Louisville, Ky.
Chatta. Boiler & Tank Co., Chattanooga, Tenn.
Chicago Bridge & Iron Works, Chicago, Ill.
Columbian Steel Tank Co., Kansas City, Mo.
Dover Boiler Wks., New York.
Fouts Co., C. C., Middletown, O.
Graver Corporation, E. Chicago, Ind.
Hardesty Mfg. Co., R., Denver, Col.
Hendrick Mfg. Co., Carbondale, Pa.
Honhorst Co., Jos., Cincinnati, Ohio.
Lancaster Iron Works, Lancaster, Pa.
Pacific Tank & Pipe Co., San Francisco, Cal.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Riter-Conley Co., Pittsburgh, Pa.
Scaife & Sons, Wm. B., Oakmont, Pa.
United Iron Works, Kansas City, Mo.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.
Wayne Tank & Pump Co., Ft. Wayne, Ind.

TANKS, WOOD

Caldwell Co., W. E., Louisville, Ky.
Davis & Son, G. M., Palatka, Fla.
Eagle Tank Co., Chicago, Ill.
Hauser-Stander Tank Co., Cincinnati, O.
Kalamazoo Tank & Silo Co., Kalamazoo, Mich.
National Tank & Pipe Co., Portland, Ore.
Pacific Tank & Pipe Co., San Francisco, Cal.
Redwood Manufacturers Co., San Francisco, Calif.
Stearns Lumber Co., A. T., Boston, Mass.
U. S. Wind Engine & Pump Co., Batavia, Ill.
Wendnagel & Co., Chicago, Ill.

TANK WAGONS

*Heil Co., Milwaukee, Wis.
*International Motor Co., New York.
Acme Road Mach. Co., Frankfort, N. Y.
Avery Co., Peoria, Ill.
Case Threshing Mach. Co., J. I., Racine, Wis.

TAPES, STEEL AND METALLIC

Dietzgen Co., Eugene, New York.
Keuffel & Esser Co., Hoboken, N. J.
Lufkin Rule Co., Saginaw, Mich.
Starrett, L. S., Athol, Mass.

TAPPING MACHINES

Hays Mfg. Co., Erie, Pa.
Mueller Mfg. Co., H., Decatur, Ill.
Smith Mfg. Co., A. P., E. Orange, N. J.

TAR

American Tar Products Co., Chicago, Ill.
Barrett Co., New York.

TAR KETTLES. (See Kettles)

TIES, STEEL

*Koppel Ind. Car & Equip. Co., Koppel, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Sweet's Steel Co., Williamsport, Pa.

TIMBER CLAMPS

Pyle-Rogers Corp., New York.

TIRES, RUBBER. (For Motor Trucks.)

*Goodrich Rubber Co., Akron, O.
Firestone Tire & Rubber Co., Akron, O.
Fisk Tire Co., Akron, O.
Goodyear Tire & Rubber Co., Akron, O.
Kelly Springfield Tire Co., New York.
Republic Rubber Co., Youngstown, O.
U. S. Tire Co., New York.

TOOL HOUSES, PORTABLE STEEL

*Littleford Bros., Cincinnati, O.

TOWERS (See Standpipe Tanks and Towers)

TRACKS, INDUSTRIAL AND PORTABLE

*Koppel Ind. Car & Equip. Co., Koppel, Pa.
Atlas Car & Mfg. Co., Cleveland, Ohio.
Bethlehem Steel Co., Bethlehem, Pa.
Chase Fdry. & Mfg. Co., Columbus, O.
Easton Car & Constn. Co., New York.
Hunt Co., Inc., C. W., West New Brighton, N. Y.
Lakewood Engineering Co., Cleveland, O.

TRACTORS

*Best Tractor Co., C. L., San Leandro, Cal.
*Heil Mfg. Co., Peoria, Ill.
*International Motor Co., New York.
*Monarch Tractors, Inc., Watertown, Wis.
Advance-Rumely Thresher Co., Laporte, Ind.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Avery Co., Peoria, Ill.
Barrett-Cravens Co., Chicago, Ill.
Bates Machine & Tractor Co., Joliet, Ill.
Case Threshing Machine Co., J. I., Racine, Wis.
Clark Trucktractor Co., Chicago, Ill.
Cleveland Tractor Co., Cleveland, O.
Dayton-Dowd Co., Quincy, Ill.
Fairbanks, Morse & Co., Chicago, Ill.
Four Wheel Drive Auto Co., Clintonville, Wis.
Hart-Parr Co., Charles City, Iowa.
Huber Mfg. Co., Marion, O.
International Harvester Co., Chicago, Ill.
J. T. Tractor Co., Cleveland, O.
Little Giant Co., Mankato, Minn.
Moline Plow Co., Rock Island, Ill.
Oliver Tractor Co., Knoxville, Tenn.
Shaw-Enochs Tractor Co., Minneapolis, Minn.
Twin City Co., Minneapolis, Minn.
White Company, The, Cleveland, O.

TRAFFIC PAINT

Hoosier Paint Wks., Ft. Wayne, Ind.
Tropical Paint & Oil Co., Cleveland, Ohio.
Truscon Laboratories, Detroit, Mich.

TRAFFIC SIGNS. (See "Signs, Traffic")

TRAILERS FOR TRUCKS AND TRACTORS

Arcadia Trailer Corp., Newark, N. Y.
Eagle Wagon Works, Auburn, N. Y.
Highway Trailer Co., Edgerton, Wis.
La Plant-Choate Mfg. Co., Cedar Rapids, Ia.
Lee Trailer & Body Co., Chicago, Ill.
Troy Wagon Works, Troy, O.
Warner Mfg. Co., Beloit, Wis.
Watson Products Corp'n., Canastota, N. Y.

TRAILERS, INDUSTRIAL

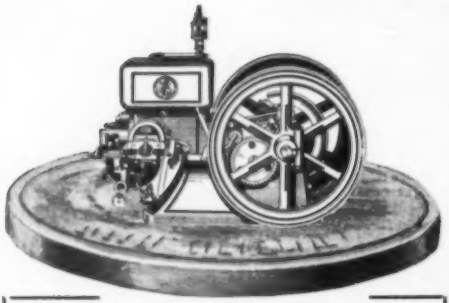
Chase Fdry. & Mfg. Co., Columbus, O.
Electric Wheel Co., Quincy, Ill.
Lakewood Engineering Co., Cleveland, O.
Lee Trailer & Body Co., Chicago, Ill.

TRAMWAYS, AERIAL WIRE ROPE

Broderick & Bascom Rope Co., St. Louis, Mo.
Leschen & Sons Rope Co., A., St. Louis, Mo.

TRANSFORMERS

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Kuhlman Electric Co., Bay City, Mich.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.



What Gigantic Power A Dollar Now Buys!

Right across Indiana from our factory, a 3-h.p. Hercules drives a concrete-mixer, ten hours a day, week in, week out.

The man who runs it says a little more than three gallons of gasoline keeps it going all day long.

Around here today the tank-wagon was getting 20 6/10 cents a gallon for gas. At that rate, this hardworking little Hercules runs more than a day and a half on a dollar's worth of fuel.

Just stop and figure what terrific vast energy this little mighty prime-mover delivers for that little money!

Five million nine hundred and forty
thousand foot pounds an hour—
Equal to tossing a thousand pounds
a hundred feet high every minute—

for less than
seven cents
($0.0686, to be exact)
per hour!!!

The Hercules that does this chore was new—in 1916! Its owner has bought it three piston rings and a 40-cent casting as its total repair bill in seven years!

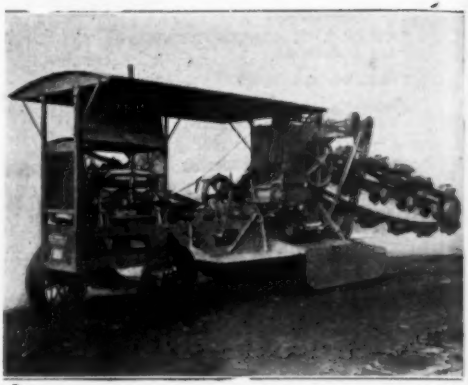
If that isn't the kind of a power-plant your jobs deserve, what under the canopy would be?

Whatever the job—concrete mixing; sawing; hoisting; compressed air conveying; stone crushing; ANYthing—there's a Hercules that fits the need to a T.

The book we want to mail you tells every detail a practical man wants to know about. Where shall we mail it to reach you quick?

THE HERCULES CORPORATION
Engine Division, Dept. B, Evansville, Ind.

HERCULES ENGINES



Parsons New Model 30 equipped with Climax Model T, 5½" x 7" "Trustworthy" Engine.

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CLIMAX

"The Trustworthy Engine"

The best proof of the remarkable dependability of Climax power is that no regular user has ever found it advisable to change to any other make.

MODERATE SPEED
HEAVY DUTY
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CLIMAX ENGINEERING CO.
1 W. 18th Ave., Clinton, Ia.

Builders of Internal Combustion Engines for Automotive and Industrial Power Purposes

TRANSITS AND LEVELS. (See Instruments.)

TRANSMISSION MACHINERY, POWER
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Chain Belt Co., Milwaukee, Wis.
Dodge Mfg. Corp'n, Mishawaka, Ind.
General Electric Co., Schenectady, N. Y.
Link-Belt Co., Chicago, Ill.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

TRASH CANS. (See Cans)

TREADS, SAFETY
American Abrasive Metals Co., New York.
American Mason Safety Tread Co., Lowell, Mass.
Concrete Steel Co., New York.
Hendrick Mfg. Co., Carbondale, Pa.
Norton Co., Worcester, Mass.

TRENCH BRACES. (See Braces, Trench)

TRENCH EXCAVATORS, (see Excavators, Ditch & Trench)

TRENCH PUMPS. (See Pumps, Contractors')

TURBINES
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
De Laval Steam Turbine Co., Trenton, N. J.
General Electric Co., Schenectady, N. Y.
Ingersoll-Rand Co., New York.
Midwest Engine Co., Indianapolis, Ind.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

TURNTABLES FOR MOTOR TRUCKS
Blaw-Knox Co., Pittsburgh, Pa.
Champion Eng. Co., Kenton, O.
The Hug Co., Highland, Ill.
Western Structural Co., Moline, Ill.

USED MACHINERY
(See Contractors' Used Equipment.)

VALVE CONTROL APPARATUS, ELECTRIC
Payne Dean, Ltd., New York.

VALVES, GATE AND INDICATOR POSTS
*Ludlow Valve Mfg. Co., Troy, N. Y.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Columbian Iron Wks., Chattanooga, Tenn.
Crane Company, Chicago, Ill.
Darling Valve & Mfg. Co., Williamsport, Pa.
Eddy Valve Co., Waterford, N. Y.
Fairbanks Co., The, New York.
Iowa Valve Co., Oskaloosa, Ia.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Lunkenheimer Co., Cincinnati, O.
Reading Steel Casting Co., Inc., Bridgeport, Conn.
Rensselaer Valve Co., Troy, N. Y.
Smith Mfg. Co., A. P., East Orange, N. J.
Wood & Co., R. D., Philadelphia, Pa.

VALVE BOXES AND HOUSINGS
*Central Foundry Co., New York.
*Clark Co., H. W., Mattoon, Ill.
*Ludlow Valve Co., Troy, N. Y.
*U. S. C. Ir. Pipe & Fdry. Co., Burlington, N. J.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Clow & Sons, J. B., Chicago, Ill.
Columbian Iron Works, Chattanooga, Tenn.
Darling Valve & Mfg. Co., Williamsport, Pa.
Eddy Valve Co., Waterford, N. Y.
Fairbanks Co., The, New York.
Iowa Valve Co., Oskaloosa, Ia.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Mueller Mfg. Co., H., Decatur, Ill.
Pratt & Cady Co., Inc., Hartford, Conn.
Rensselaer Valve Co., Troy, N. Y.
Smith Mfg. Co., A. P., East Orange, N. J.
Wood & Co., R. D., Philadelphia, Pa.

VENTILATORS
American Blower Co., Detroit, Mich.
Edwards Mfg. Co., Cincinnati, O.
Milwaukee Corrugating Co., Milwaukee, Wis.

WAGONS. (See Dump Carts and Wagons.)

WAGON BODIES. (See Dump Bodies)

WAGON LOADERS. (See Loaders, Gravel and Wagon)

WALLBOARD
*Carey Co., Philip, Cincinnati, Ohio.
Beaver Board Companies, Buffalo, N. Y.
Bird & Son, inc., E. Walpole, Mass.
Cornell Wood Products Co., Chicago, Ill.
Haverhill Box Board Co., Haverhill, Mass.
MacAndrews & Forbes Co., New York, N. Y.
Plastergon Wall Board Co., Buffalo, N. Y.
United States Gypsum Co., Chicago, Ill.
Upson Co., The, Lockport, N. Y.
Waldorf Paper Products Co., St. Paul, Minn.

WALL TIES
Concrete Steel Co., New York, N. Y.
Consolidated Expanded Metal Co., Braddock, Pa.
Berger Mfg. Co., Canton, O.
Milwaukee Corrugating Co., Milwaukee, Wis.
Niagara Metal Stamp. Corp., Niagara Falls, N. Y.

WATER MAIN CLEANING
*National Water Main Cleaning Co., New York.

WATER MAIN TAPPING MACHINES
Mueller Mfg. Co., H., Decatur, Ill.
Smith Mfg. Co., A. P., East Orange, N. J.

WATER METERS. (See Meters, Water.)

WATERPROOFING COMPOUNDS AND MATERIAL
*Barber Asphalt Co., Philadelphia, Pa.
*Carey Co., Philip, Cincinnati, Ohio.
*Servicised Products Co., Chicago, Ill.
*Standard Oil Co. (Indiana), Chicago, Ill.
*Texas Company, New York.
Anti-Hydro Waterproofing Co., Newark, N. J.
Atlantic Refining & Asphalt Corp., Phil'a, Pa.
Barrett Company, New York.
General Fireproofing Co., Youngstown, O.
Master Builders' Co., Cleveland, O.
Minwax Co., The, New York.
Protexol Corpn., New York.
Ruberoid Co., New York.
Sandusky Cement Co., Cleveland, O.
Sonneborn Sons, Inc., New York.
Toch Brothers, New York.
Truscon Laboratories, Detroit, Mich.

WATER PURIFICATION. (See also Filters.)
*Wallace & Tiernan Co., Inc., Newark, N. J.
Electro Bleaching Gas Co., New York.
Mathieson Alkali Works, Inc., New York.
Penna. Salt Mfg. Co., Philadelphia, Pa.
R. U. V. Company, New York.

WATER REGULATORS
*Union Water Meter Co., Worcester, Mass.
Mueller Mfg. Co., Decatur, Ill.
Pacific Flush Tank Co., Chicago, Ill.

WATER SOFTENERS
American Water Softener Co., Philadelphia, Pa.
Graver Corporation, E. Chicago, Ind.
International Filter Co., Chicago, Ill.
N. Y. Continental Jewell Filtr. Co., Nutley, N. J.
Permutit Company, New York.
Roberts Filter Mfg. Co., Darby, Pa.
Scaife & Sons, W. B., Pittsburgh, Pa.
Wayne Tank & Pump Co., Ft. Wayne, Ind.

WATER WASTE DETECTION
*Clark & Co., N. W., Mattoon, Ill.
*Pitometer Co., New York
Simplex Valve & Meter Co., Philadelphia, Pa.

WATER WHEELS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Leffel & Co., Jas., Springfield, O.
Pelton Water Wheel Co., San Francisco, Cal.
Smith Company, S. Morgan, York, Pa.

WATER WORKS PUMPS (See "Pumps, Centrifugal" and "Pumps, Deep Well")

WELDING APPARATUS
General Electric Co., Schenectady, N. Y.
Lincoln Electric Co., Cleveland, O.

Exclusive Improvements

Attention to details has put the Sterling barrow in a class by itself. Self-lubricating bearings —Handle clamps instead of bolts —Riveted leg construction — Steel leg shoes—Malleable wheel guards—Keyed cold rolled steel axles.

These are Sterling improvements which lessen repair costs and add to the efficiency and durability of Sterling wheelbarrows. These are the refinements which spell economy for you.

Sterling Wheelbarrow Company

NEW YORK
BOSTON
CLEVELAND
BUFFALO

MILWAUKEE, WIS.

CANADIAN AGENTS: ROBERTS LIMITED, MONTREAL, TORONTO, WINNIPEG, VANCOUVER

DETROIT
CHICAGO
ST. LOUIS
SPOKANE

Milburn Company, Alex., Baltimore, Md.
Oxweld Acetylene Co., Newark, N. J.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

WELL SCREENS

Cook, Inc., A. D., Lawrenceburg, Ind.
Johnson, Edw. E., Inc., St. Paul, Minn.

WELL-DRILLING AND BLAST HOLE MACHINES

*Keystone Driller Co., Beaver Falls, Pa.
*Loomis Machine Co., Tiffin, O.
American Well Works, Aurora, Ill.
Armstrong Mfg. Co., Waterloo, Iowa.
Leidecker Tool Co., Marietta, Ohio.
Sanderson Cyclone Drill Co., Orrville, Ohio.
Sparta Iron Wks. Co., Sparta, Wis.
Star Drilling Machine Co., Akron, O.

WHEELBARROWS

*Sterling Wheelbarrow Co., Milwaukee, Wis.
Akron Barrow Co., Cleveland, O.
Jackson Mfg. Co., Harrisburg, Pa.
Lansing Co., Lansing, Mich.
Puffer-Hubbard Mfg. Co., Minneapolis, Minn.
Sidney Steel Scraper Co., Sidney, O.
Steubner Iron Wks., G. L., L. I. City, N. Y.
Toledo Wheelbarrow Co., Toledo, O.

WINCHES

Bethlehem Shipbuilding Corp., Bethlehem, Pa.
Chisholm-Moore Mfg. Co., Cleveland, O.
Clyde Iron Wks., Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Lidgerwood Mfg. Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Mundy Hoisting Eng. Co., J. S., Newark, N. J.

WINDOW FRAMES AND SASH. (Metallic.)

*Truscon Steel Co., Youngstown, O.
Bayley Co., Wm., Springfield, O.
Detroit Steel Products Co., Detroit, Mich.
Friedrich Co., E. H., Holyoke, Mass.
Lupton's Sons Co., David, Philadelphia, Pa.
McFarland Co., J. C., La Porte, Ind.
Penn Metal Co., Boston, Mass.
Sykes Co., Chicago, Ill.

WIRE AND CABLE

American Steel & Wire Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Habirshaw Elec. Cable Co., Inc., N. Y.
Hazard Mfg. Co., Wilkesbarre, Pa.
Macwhyte Co., Kenosha, Wis.
National India Rubber Co., Bristol, R. I.
New York Insulated Wire Co., New York.
Okonite Co., Passaic, N. J.
Roebling's Sons Co., J. A., Trenton, N. J.
Safety Ins. Wire & Cable Co., New York.
Simplex Wire & Cable Co., Boston, Mass.
Standard Underground Cable Co., Pittsburgh, Pa.
Tubular Woven Fabric Co., Pawtucket, R. I.
Waterbury Co., New York.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE GLASS

Mississippi Wire Glass Co., New York.

WIRE MESH REINFORCEMENT

*National Steel Fabric Co., Pittsburgh, Pa.
*Truscon Steel Co., Youngstown, O.
American Steel & Wire Co., Chicago, Ill.
Wickwire Spencer Steel Corp., New York.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE ROPE. **(See Rope, Wire.)**

WOOD BLOCKS **(See Paving Blocks)**

WOODWORKING MACHINES

*Ransome Concrete Mach. Co., Dunellen, N. J.
Fairbanks, Morse & Co., Chicago, Ill.

WOOD PRESERVATIVES

Barrett Company, New York.
Protexol Corpn., New York.
Republic Creosoting Co., Indianapolis, Ind.
Truscon Laboratories, Detroit, Mich.

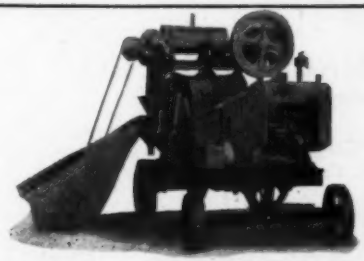
WRECKING BARS

*Anderson Bros. Mfg. Co., Rockford, Ill.

WRENCHES

Erie Tool Works, Erie, Pa.
Greene, Tweed & Co., New York.
Greenfield Tap & Die Corp., Greenfield, Mass.
Lowell Wrench Co., Worcester, Mass.

PITOMETER SURVEYS
FIND LEAKS AND STOP WATER WASTE
52 CHURCH ST. PITOMETER COMPANY NEW YORK CITY



Atlas YARDAGE

120 to 150 Cu. Yds. in 10 hours with an Atlas one bag Mixer.

Atlas Mixers are of sturdy dependable construction, and the 7-S is regularly equipped with multiple cylinder LeRoi Engine, giving excess power.

We build 3½ ft., ½ bag, 1 bag and 2 bag Mixers.

Dealers write for agency proposition.

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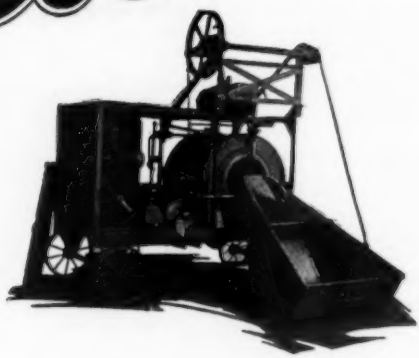

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Building the Niagara Falls Power Tunnel

Manual Work on This Project Was Reduced to Minimum, All Excavated Earth, Rock and Construction Material Being Handled by Machinery

By C. D. McArthur

UNDER the Federal Water Power Act, authorizing the diversion of 19,500 second-feet of water from the American side at Niagara Falls, the consolidation of the plants of the Niagara Falls Power Company and the Hydraulic Power Company, which took place during the war, placed under one head the authority to enlarge upon the present methods of utilizing this water.

The Niagara Falls Power Company's plants, Numbers 1 and 2, which have a capacity of 115,500 h.p., are located above the falls. These two plants take 8,600 second-feet of water from the upper river directly into the penstocks to the turbines in the wheel-pits, thence to the tunnel, which is under the city, to the river below. The maximum efficiency of these plants is 12 h.p. per second-foot.

The Hydraulic Power Company's plants, known as Hydraulic No. 2, Hydraulic No. 3, and Hydraulic No. 3 Extension, which have a combined capacity of 250,000 h.p., are located below the falls, and receive their water from the hydraulic canal, which carries 10,900 second-feet to the canal basin or forebay, from which it drops through penstocks to the wheels below; giving an efficiency of 22 h.p. per second-feet at a head of 217 feet.

Considerable interest has been taken in the Hydraulic No. 3 Extension, where three 37,500-h.p. reaction units were installed in 1920. More interest, however, is being taken in the installation of three 70,000-h.p. reaction wheels, which is now going on at these plants. This 210,000-h.p. unit will require 10,000 second-feet of water; so, in order not to go beyond the available supply of 19,500 second-feet it was decided to shut down the Niagara Falls Power Company's plants, Nos. 1 and 2, holding them in reserve, and to divert this water through a

BUILDING THE 21-FOOT DIAMETER PENSTOCKS FOR UNIT NO. 10, SHOWING THE STEEL FORMS IN OPERATION ON A 45-DEGREE SLOPE

tunnel to the canal basin of the Hydraulic Company's plants.

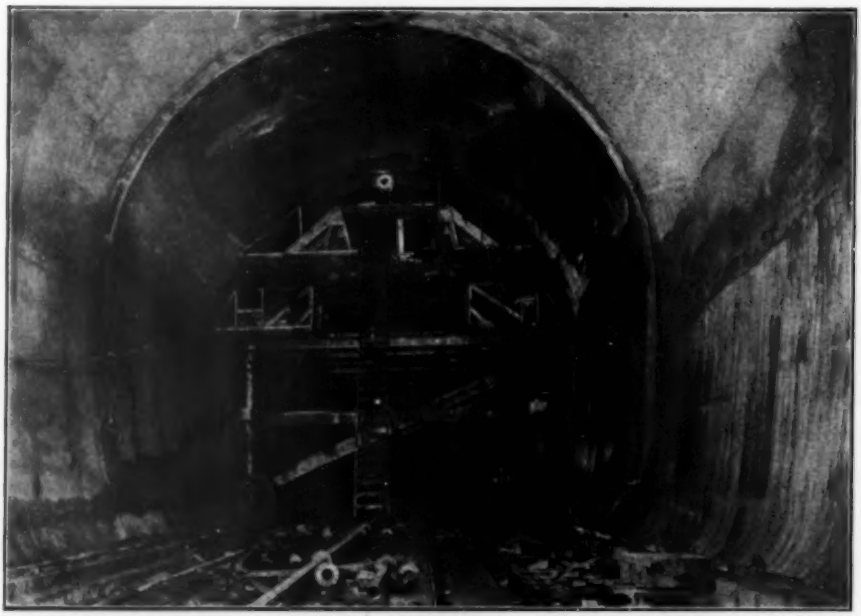
This new project includes, besides the tunnel, which is 4,300 feet in length, the tunnel intake works; the outlet and forebay; three slope tunnel penstocks; a gate-house with head gates and controlling works, and a new power-house with three 70,000-h.p. water-wheels attached to the electric generators.

The hydraulic pressure tunnel tips down from from the upper river level at Port Day at a descending grade of 5.5 per cent slope for a distance of 950 feet. It reaches a depth of 134 feet and for the next level section of 2,300 feet it passes under the city of Niagara Falls and rises for the remainder of its length on a 6 per cent grade to the canal forebay.

The water is taken from the upper river level at about a mile above the falls. The form of construction of the intake works is such that there is no acceleration of the flow of water between the river and the intake portal. After the water passes the portal, its speed rapidly increases so that the flow within the tunnel is at the rate of 12 feet per second.

The cross-section of the tunnel is 32 by 32 feet, horseshoe shape. The tunnel was driven through solid rock, consisting principally of a tough limestone. The drilling was done entirely by jackhammer drills mounted by twos and threes on extra heavy pipe columns, which were braced between the roof and the floor. Dynamite was used as an explosive. Compressed-air-operated shovels mucked the tunnel into 4-yard cars, which were hauled by electric mine locomotives. Electric-operated hoists, equipped with steel buckets, raised the rock to the ground level, where it was unloaded directly into trucks for transfer to the disposal ground. The progress in driving this tunnel averaged 9 feet per day in the heading and 7 feet per day on the bench.

The tunnel and penstocks were lined throughout with Blaw-Knox steel forms. On account of the extra smooth finish which is required in tunnels of this kind, it was necessary to use steel forms to minimize the labor required to obtain this finish. Wood forms could not have produced the finish which was secured on this work.



SCENE AT STATION NO. 3-C OF THE 32 x 32-FOOT PRESSURE TUNNEL OF THE NIAGARA FALLS POWER COMPANY, SHOWING STEEL FORMS IN OPERATION

The steel forms were made in 25-foot sections. Being of a movable type, they were carried on heavy structural steel travelers, making them self-contained units. On account of the rapid progress in pouring the forms, great care was used in their design, not only for the work which the form had to do, but in order to reduce to a minimum the manual work of handling the forms. The pneumatic method of placing concrete was used. The idea of reducing manual work to a minimum was carried out in this entire project, as all of the machinery entering into the construction work was the most modern which could be obtained.

A public inspection was made of this project during the week of March 26, 1923. It is the

intention of the company to unwater the hydraulic canal so that it can be cleaned out and repaired. They intend to turn the water into the new tunnel at an early date, some considerable time before the new generators are ready for operation. After the hydraulic canal has been put in condition, and before the three new units are ready for operation, it is intended to divert the water back into the canal and unwater the tunnel for observation.

The thoroughness with which this work has been carried out and the provisions made for observing the flow of water through the tunnel, will lead to an exact check on many of the existing formulæ for the flow of water through conduits.

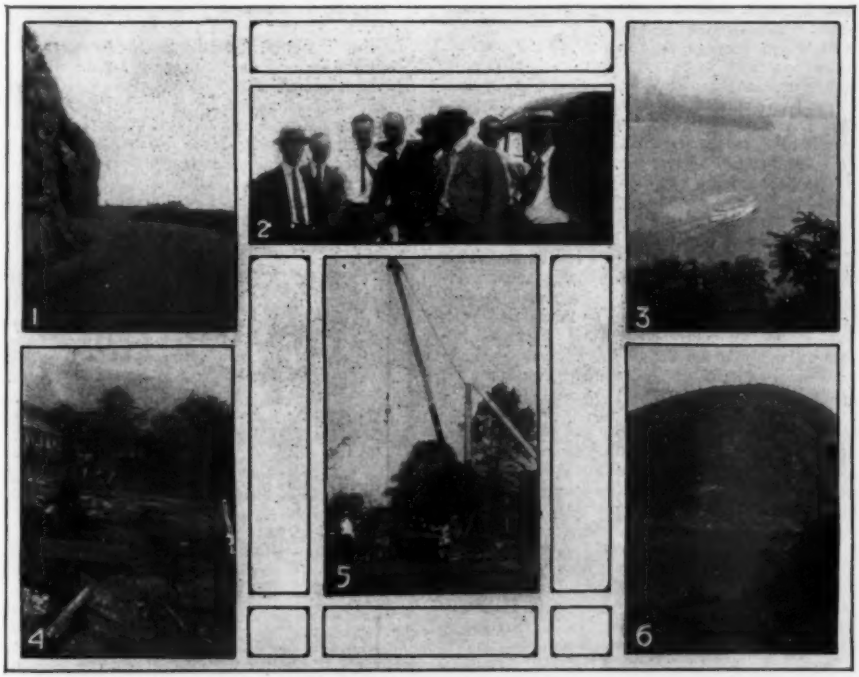
The work is being carried on by the Niagara Falls Power Company under direct supervision of John L. Harper, Vice-President and Chief Engineer. The construction work is under the direction of O. D. Dales, Construction Engineer. The contractors for the entire construction are the Reed-Coddington Engineering Company, of Niagara Falls, N. Y.

Asphalt Paving and the Storm King Highway

Inspection Tour Shows Remarkable Condition of Asphalt Roads Near New York City

THROUGH the courtesy of the Asphalt Association, 25 West 43rd Street, New York City, an inspection trip of asphalt paving within 50 miles of New York City and the Storm King Highway was made on June 5, 1923, by a representative group of engineers interested in highway work.

The trip started north on Fifth Avenue, New York City, traversing the 3-inch sheet asphalt laid on 6-inch Portland cement concrete in 1912. This street carries 20,000 vehicles per day and is in remarkably good condition. Continuing through Central Park, to 72nd Street and up Riverside Drive, the roads consisted of sheet asphalt, asphaltic concrete and asphalt block, the latter being laid on a macadam base in 1904. After crossing the Hudson River and proceeding through Leonia, N. J.,



SOME VIEWS TAKEN ON THE INSPECTION TRIP OF STORM KING HIGHWAY

1. View of Storm King Highway at highest point above Hudson River. 2. Group of engineers on inspection trip. 3. The "Robert Fulton," one of the largest Hudson River boats, as seen from the parapet of Storm King Highway. 4. First excavation for new Bear Mountain Hudson River Bridge. Result of first blast for bridge anchors. 5. Derrick and mixer, the first construction machinery for the new bridge. 6. View across Hudson River, looking east toward Anthony's Nose, site of new Bear Mountain Hudson River Bridge crossing

to Bogota and Hackensack to Hohokus, 6½ miles of 3-inch Topeka mix on 6-inch macadam laid in 1915 was found to be in very good shape. This was followed by 4 miles of 3-inch coarse Topeka on 6-inch macadam base laid in 1913 and then by 6 miles of 3-inch Amiesite on 6-inch macadam, laid in 1911. The 16¼ miles of tar macadam and bituminous macadam from Tuxedo, N. Y., through Bear Mountain Park showed the results of the remarkably heavy traffic for which it was not designed.

An inspection was made of the site of the new Bear Mountain Hudson River Bridge, described in detail elsewhere in this issue.

The 4 miles of Storm King Highway is built of 3-inch asphaltic macadam on 5- and 6-inch base and was completed and opened for traffic last November. This road is located on the west bank of the Hudson between West Point and Cornwall in Orange County, N. Y. When the initial survey was made, it was necessary to let the engineers down the precipitous face of the cliff by means of ropes. Excavation, begun in 1915, included the removal of 250,000 cubic yards of rock and 50,000 cubic yards of earth, or the equivalent of at least 8,000 car-loads of material, so that it was literally the moving of a mountain.

A masonry wall to the extent of 35,000 cubic yards was constructed. At places the retaining wall is 40 feet in height. A paved surface 18 to 20 feet wide of asphalt macadam, 3 inches thick, was laid in 1922 on a broken stone foundation 5 to 6 inches thick. A surface coat of 1¾ gallons of asphalt per square yard was first applied, followed by a seal coat of ½-gallon per square yard.

The Storm King Highway has cost, exclusive of engineering, about $850,000 and probably touches the peak of highway cost in this country, at least in the East, but when it is considered that in addition to the recreation value of Storm King Highway, it reduces the traveling distance between West Point and Cornwall from 25 miles to less than 5 miles and is a link in an unbroken stretch of 50 miles between the Dyckman Street ferry, New York, to Newburgh, N. Y., its economic value is of no mean importance.

The very severe winter of 1922-23 has left no scars on this remarkable highway and it has not been damaged by the several rock slides which have occurred, although the slides partially closed the highway from time to time, during last winter and the early portion of the spring of 1923.

The following engineers and newspaper men made the inspection trip on June 5 under the auspices of the Asphalt Association:

Gen. H. L. Scott, Chairman, State Highway Commission, Trenton, N. J.; Col. R. K. Compton, Chairman, Paving Commission, Baltimore, Md.; C. J. Bennett, State Highway Commissioner, Hartford, Conn.; C. M. Pinckney, Chief Engineer of Public Works, New York City; R. A. MacGregor, Department of Public Works, Borough of Manhattan, New York City; T. S. Oxholm, Chief Engineer, Borough of Richmond, New York City; Maj. W. A. Welch, General Manager, Palisades Interstate Park; O. A. Smith, County Superintendent of Highways, Suffolk County, N.Y.; H. F. Harris, County Engineer, Mercer County, N. J.; J. F. Loughran, County Superintendent of Highways, Ulster County, N. Y.; Richard Mitchell, County Superintendent of Highways, Putnam County, N. Y.; C. H. Smith, County Superintendent of Highways, Orange County, N. Y.; W. F. Starks, County Engineer, Nassau County, N. Y.; Harvey Snook, County Engineer, Sussex County, N. J.; James Sturdevant, Division Engineer, New York State Highway Commission, Poughkeepsie, N. Y.; C. D. Bickley, County Engineer, Essex County, N. J.; George Paddock, President, New Jersey Good Roads Association; G. H. Miller, District Engineer, U. S. Bureau of Public Roads, Troy, N. Y.; W. W. Chase, Manager, Metropolitan Division, American Automobile Association; Frank W. Crane, Automobile Editor, *New York Times;* A. P. Folwell, Editor, *Public Works;* Duncan Curry, *New York American;* C. E. T. Sharp, *New York Evening Mail;* John Gren, *New York Telegram;* Forrest Davis, *New York Tribune;* Theodore R. Kendall, Editor, CONTRACTORS' & ENGINEERS' MONTHLY; F. R. Field, Newark, N. J., and Herbert Spencer, New York City, Standard Oil Company of New Jersey; R. L. Christy, New York City, R. H. Beeman, Albany, N. Y., and C. S. Maschall, Stamford, Conn., Standard Oil Company of New York; and the following representatives of the Asphalt Association: J. R. Draney, President, New York City; J. E. Pennybacker, Secretary, New York City; Prévost Hubbard, Chemical Engineer, New York City; W. E. Rosengarten, Traffic Engineer, New York City; Major F. A. Reimer, District Engineer, Newark, N. J.; and C. S. Lee, Director, Highways Information Service, New York City.

Bellyaches

By Horatio Sawyer Earle

IF YOU HAVE GOT THE BELLYACHE, go into close confinement and groan: groan to your heart's content all by yourself, where no one will hear you.

You may think the above paragraph refers to a certain physical ailment, but it doesn't: it refers to certain individuals and organizations that are all the time bellyaching about conditions and their particular circumstances.

To be specific,—it refers to those who bellyached until the Adamson Law was passed, increasing the wages of a portion of the people of this country at the expense of all in the increase of freight rates, which in turn increased the cost of everything that we eat, wear or use.

It refers to the farmer organizations that are bellyaching in every session of Congress, and in every session of every Legislature about conditions and their particular circumstances; asking for special Legislation to help them at the cost of everybody else.

By doing this they become mendicants, but so severe is their mental bellyache that they don't seem to realize that they differ only in degree from those who apply for aid at the poor houses of the nation.

Every contribution by Nation or State to any class is a hand-out by others, just as much as the ten-cent bit handed to the pan-handler who accosts us in the street.

The Government is the best Government which is the least Government, and it's a pity that we do not elect lawmakers who are immune from bellyaches or the influence of bellyachers.

Legal Points for Contractors

These brief abstracts of court decisions in the contracting fields may aid you in avoiding legal difficulties. Local ordinances or state laws may alter the conditions in your community. If in doubt, consult your own lawyer

Edited by A. L. H. Street, Attorney-at-Law

Completing Work As Soon As "Practicable"

A contractor's agreement to complete work as soon as practicable was given this interpretation by the Illinois Supreme Court in the case of Williams vs. Rittenhouse & Embree, 64 Northeastern Reporter, 995:

"The words 'as soon as practicable' do not and cannot be construed to mean as quickly as the work can be done with the best appliances and the utmost facilities and extraordinary diligence. . . . The word 'practicable' and the word 'possible' may, and sometimes do, have the same meaning. If here regarded as synonymous, neither could be construed to require more than the exercise of reasonable diligence, in view of all the circumstances which might attend upon the execution of the work. It may be, and often is, possible to do that which it is wholly impracticable to do."

Waiver of Contractor's Agreement to Furnish Bond

By permitting a contractor to proceed to completion of his work without giving bond required by his contract, the bond was waived, held the Appellate Division of the New York Supreme Court in the case of Hevenor vs. Union Railway Company of New York City, 198 New York Supplement, 409.

The contract, covering railway construction, recited that the contractor "herewith" delivered a bond to indemnify the railway company against liability to patentees of any process or materials connected with the work, and to secure full performance of the contract. Before the work was started, the railway company refused to waive the bond, but it permitted the contractor to proceed without furnishing it. The Court said:

"While the railway company might have disclaimed liability on the contract on a showing that it did not receive the bond prior to any work thereunder, it could not, it seems to us, go forward with the work, accept its benefits, and, after completion, assert that it had not received the bond, which its conduct indicated it never intended to receive. . . . A waiver is proved as a matter of law by the undisputed acts or language of the party against whom the waiver is asserted, so inconsistent with its purpose to stand upon its rights as to leave no reasonable inference to the contrary."

Sufficiency of Notice to Corporate Employer of Accident to Employee

Under the New York Workmen's Compensation Act, notice delivered to a construction corporation's bookkeeper of the occurrence of an accident to an employee is not notice to the corporation, holds the Appellate Division of the New York Supreme Court in the case of Cuccia vs. John J. Roberts' Contracting Co., 198 New York Supplement, 613.

Cuccia, while working for the defendant company, sustained an injury and was awarded compensation under the New York law. An appeal to the Court resulted in a reversal, on the ground that there was no showing of service of notice of the accident on the employer. Claimant relied on a delivery of notice to the company's bookkeeper. This was held to be insufficient, because the law requires such notices to be served upon an agent or officer upon whom legal process might be served, or who is in charge of the business in the place where the injury occurred.

Powers of Public Boards in Awarding Contracts

In the case of Hibbs vs. Arensberg, 119 Atlantic Reporter, 727, question was raised before the Pennsylvania Supreme Court as to the power of a school board to award a building contract on bids which were rejected at a previous meeting. At the first meeting all bids were rejected as being too high. A week later, at an adjourned meeting, one of the bids was accepted by a vote of four of the members of the board. Two members were absent, and another, though present, did not vote. The Court decided:

"While the board thought the bids high at the first meeting, this did not conclude the question. We know of nothing in the law to prevent awarding the contract on these bids at a subsequent meeting. Notice of the later meeting should be given to all the directors, and they should all be present, if possible. The law contemplates the combined judgment of all; one of them, from experience and practical knowledge, may prove of invaluable service to the board. If all the members had notice, within a reasonable time, of the hour fixed, and a majority appeared, that majority could proceed with the transaction of business; but the letting should not be considered until the hour fixed for the meeting. We may assume, from the findings, the majority acted after the time fixed."

Contractor's Statement of Work Partially Completed

A building contract provided: "The contractor shall furnish to the architect at each time when payments become due a written report, setting forth the exact percentage of the

materials received at the building and the exact percentage of the work installed." The contractor filed a statement that "the exact percentage, as near as is possible to make it, of the materials received at the building is 8 per cent." There was a similar recital as to the percentage of work installed.

In the case of Sinnott vs. Schumacher, 187 Pacific Reporter, 105, the California District Court of Appeal decided that the statement filed did not sufficiently comply with the contract requirement. The Court said:

"The purpose of requiring such a report from the contractor to be made to the architect is manifestly to enable the architect to compute the amount of the installments which shall be due and payable to the contractor on the first day of each month, as the work progresses, and it should require no argument to show that the mere general statement or conclusion of the contractor as to the percentage of materials received and work installed upon the building at the time he requires the installment payment upon the cost thereof does not amount to a compliance with the foregoing provision of said contract."

Changing Quality of Materials After Letting Public Contract

In the case of Hibbs vs. Arensberg, 119 Atlantic Reporter, 727, lately decided by the Pennsylvania Supreme Court, it was said concerning the right of a school board to increase the quality of materials to be used in a building after a contract was awarded, without reletting the contract:

"That the directors later decided to use a little more expensive brick would not condemn the letting, or cause the directors to be liable for the increased price, or avoid the purchase. There was no such departure from the general purpose as would require reletting. Unforeseen contingencies or new ideas sometimes make it necessary to change the character or quality of material or a part of a structure from the original plan. A certain flexibility in the power of officials to take care of these matters is intended to be granted, that the law relating to public letting may not become an instrument of oppression through a too rigid construction. These officers must act honestly, reasonably, and intelligently, and a new departure must not so vary from the original plan or be of such importance as to constitute a new undertaking, which the act controls, and where fairness could only be reached through competitive bidding. Courts, however, will be slow to interfere unless it appears the officers are not acting in good faith."

"Lowest Responsible Bidder" Judicially Defined

Throwing light on the discretion that may be exercised by public boards in awarding a contract on competitive bids, under a statutory requirement for an award to the lowest responsible bidder, the Pennsylvania Supreme Court said in the late case of Hibbs vs. Arensberg, 119 Atlantic Reporter, 727:

"The term 'lowest responsible bidder' does not mean the lowest bidder in dollars; nor does it mean the board may capriciously select a higher bidder regardless of responsibility or cost. What the law requires is the exercise of a sound discretion by the directors. They should call to their assistance the means of information at hand to form an intelligent judgment. They should investigate the bidders to learn their financial standing, reputation, experience, resources, facilities, judgment, and efficiency as builders. This was not done. The Court below censures the board for omitting this important step, but it holds, inasmuch as they had ample knowledge of the successful bidder and the merit of its work, the contract could be awarded. This might do in private affairs, but will not pass when public funds are at stake; it is not the exercise of discretion. Though the directors were not bound in law to give the contract to the lowest bidder, who might be irresponsible, they were bound to investigate, and if a bidder measured up to the law's requirement as a responsible party, the board could not capriciously award the contract to another. Giving a bond alone does not make up for responsibility; we have too many bonding companies willing to indemnify almost anything. But there should be a sufficient reason, where a bidder is lowest and responsible, why the job was not given to him. And where such reason appears, the action of the board is generally conclusive."

Contract Invalidated Through Restraint of Competition

In the case of Hibbs vs. Arensberg, 119 Atlantic Reporter, 727, the Pennsylvania Supreme Court ruled that a contract let by a school board for construction of a building was vitiated through failure to provide a sufficient number of copies of the plans and specifications for all those desiring to bid. The Court said:

"Reputable contractors were deprived of the opportunity to submit prices. Competitive bidding could not be secured under these conditions. We cannot too strongly condemn the motives of some architects and public officials in following this practise; it opens the door to the grossest kind of fraud. A favored contractor, apprised in advance, may easily have the limited number of plans and specifications on file lifted by persons not bona-fide bidders, or, through a combination none too infrequent, the favored contractor submits a price (the lowest) that is high enough to give an excessive profit and pays to other higher bidders a commission "or rake-off" as their part of the gain for participating in the combination. Of course, there are other methods. Officials must have on file enough sets of plans and specifications to supply those who demand them within a reasonable time prior to the day on which the bids are to be submitted. The time within which a request is made should be sufficient to enable the architect to furnish additional copies if those first furnished have been exhausted. The Court was in error in passing over this fact as not being of sufficient consequence to restrain the work."

The Specific Uses of Excavating Machinery

Choice of Machine and Factors of Economy Outlined

IN his new book, "Engineering of Excavation," George B. Massey brings out the following points which must be carefully considered before an excavating machine of any kind is purchased or moved onto a new job by the contractor:

1. The total yardage to be handled
2. The time available
3. The material to be excavated, as regards the digging effort required
4. The bearing value of the ground
5. The angle of repose of the material as left in a bank or slope and as deposited in the spoil bank
6. The increase in volume of the material in the spoil pile, as compared with its "place measure" before disturbing it
7. The relation of the water surface, or water-table, to the original and new ground levels and the highest and lowest elevations the water surface may be made to assume
8. The amount of water available if required for hydraulic dredges
9. Availability of good water for any boilers in use
10. The type of machine
11. The size of machine
12. Difficulty of getting the machine onto and away from the work
13. Fuel, depending largely on cost delivered at the machine
14. Providing for the crew on the machine, or lodging and feeding elsewhere
15. The amount of material which can be excavated at each move of the machine
16. If the material has to be removed to a distance, the grades and curves, the gage and weight of rail, the type of car and weight of locomotive
17. Special machine attachments which will reduce the number of men required
18. The width and condition of the path or channel for the machine
19. Protection of machinery during flood conditions
20. Excavation by blasting

Enlarging on the above points:

Yardage a Prominent Factor

The total yardage to be handled often decides whether it is worth while to put any machine at all on the work. If the yardage is very large, the relative expenses of moving machines to and from the work will be so small that they will affect the cost per cubic yard of excavation very little. On the other hand, the larger the yardage the more necessary is it to use machinery which will do the work at the lowest possible cost per cubic yard. On a very large piece of work, a very slight saving per cubic yard will go a long way toward the first cost of large, strong machines.

Time Available

The time available affects the cost of the work and the type and size of machine to be used. If limited, it usually means using a larger machine than necessary or duplicating equipment. There is always a most economical period for the duration of any excavating job. In general, this would be the time required for one machine of each necessary type to do all of the work for which it was especially adapted. It involves additional expense to put any more machines on the work. On the other hand, there is a fixed charge for superintendence, bond, etc., which goes on from month to month. Two machines of a type may not require any more superintendence or other overhead expense than one. Any shortening of the time for doing the work will reduce, by a certain number of months, the monthly overhead charge. A happy medium has to be selected.

It is always advisable in obtaining bids for any piece of work to ask for two bids, one based on the desired time for completion and one based on the bidder's most economical time. The difference is apt to be considerable enough to make the change of time a matter of careful consideration.

It does no good to specify two different amounts of time, in asking for bids, unless the work has been carefully estimated and the economical period ascertained.

Type of Material to Be Excavated

The material to be excavated often governs the type and size of machine to be used, regardless of all other considerations. Unless under water, rock which requires blasting almost always demands a heavy standard two-truck steam shovel, especially if the blasting expense is to be kept down to a reasonable figure. Blasting so as to furnish only small pieces which

The Engineering of Excavation.—By George B. Massey, Vice-President, Randolph Perkins Company, John Wiley & Sons, Inc., New York. 1923. VI + 376 pp.

A practical book on excavating problems and the application of machinery to them. A large portion of the text consists of original notes by the author, of information obtained first hand in the field, and of up-to-date information on present-day excavating methods and machinery. This book is of distinct value to the contractor or government official in facilitating the choice of excavating machinery, as it is always possible by analyzing an excavation problem to ascertain what type and size of machine will do the work better and more cheaply than any other.

The book is replete with figures, folding plates and tables, giving reliable information with regard to sizes and capacities of steam shovels and buckets, records of work done, the blasting of ditches, quantity and pressure of water for hydraulic excavating, cubic yards excavated per hour by hydraulic dredges, rate of stripping with various machines, data on large revolving shovels, standard shovels, small revolving shovels, dragline excavators, power excavators, dry land dredges, trench-digging machines, buckets, industrial locomotives, drilling and blasting, scows and barges, boilers, fuel, electric drive and wire rope, and the application of machinery to work.

can be handled by small dippers or buckets is expensive.

Very sticky clay will often cut down the yardage of a machine by sticking in the bucket to such an extent as to require the substitution of a larger machine which would not have been considered otherwise. Very slippery clay, when dumped, spreads out so much that a larger machine is often necessary to put the spoil where it will not flow back into the cut.

Quicksand indicates the presence of water and the necessity of lowering the water-table or raising it and using floating equipment.

The Bearing Value of the Ground

The bearing value of the ground is a point which must be determined in soft ground before a machine can be put on it. A machine will move rapidly over ground where it would surely mire if it remained long enough at any one point to do any work. The pressure per square foot may be reduced by the use of machines which lay their own tracks, by running the machine on tracks with long ties, or by the use of platforms of large area which can be handled by the machine, if it is of the full-swing type, such as a dragline or full-swing steam shovel.

The following comparisons are useful: A horse walking exerts a pressure of 3,000 pounds per square foot; a horse standing, 1,500 pounds per square foot; a man walking, 480 pounds per square foot; and a man standing, 240 pounds per square foot. Machines working on very marshy ground have to be arranged so as to reduce the pressure per square foot to 250 pounds or 200 pounds. Most special tread machines have a bearing value of 1,500 pounds per square foot.

Angle of Repose of Material

The angle of repose of material when placed in the spoil bank will be: dry sand, 1½ to 1; gravel, dry clay or soil, 1⅓ to 1; and rocks, cobbles and hard earth, 1¼ to 1. If deposited under water, the sand and gravel increases to 2 to 1 and the soil to 3 to 1 and 4 to 1, the rock remaining 1¼ to 1. In depositing sand by a hydraulic dredge, it usually takes a slope of 5 to 1 or even 8 to 1, with 7 to 1 as about the average which can be expected. It is usual to assume a slope of 2½ to 1 for all sand, gravel, light clay or soil when deposited in a dry state above the water-level. A wet, slimy clay will sometimes spread out to a very flat slope. Hard soil and clay will stand in place in a bank at a very steep slope for some time and can often be left vertical by a machine without danger of falling before the machine has finished its cut and has reached the same spot on its next cut.

The angle of repose of material of a shale nature or with a considerable percentage of flat material can be made to stand at a steeper angle at the top of the slope of a spoil bank by dumping enough material ahead of the main spoil pile in the form of a relatively low ridge with side slopes of 1¼ to 1 and then digging away the half nearer to the machine. This leaves the rest of the material with a slope the reverse of the slope of the ridge so that it will stand up to a slope of ¾ to 1¾ horizontal to 1 vertical. This is known as a "buck wall." It can be built only of flat material.

"Swelling" of Material

The material when in place before excavation usually has no voids, or the voids represent a small proportion of the total space occupied by the material. As soon as it is disturbed, however, there is a tendency for fine material to run out of its position between larger material and leave voids among the larger pieces. This is called "swelling" of the material, and it must always be specified whether yardage is to be measured "in place" or in the spoil pile. It can be as high as 20 per cent for material containing large and small particles. Car measure includes the swell.

Water for Flotation and Boilers

The elevation of the water-level in respect to the elevation at which the machine must be located decides whether a floating or a "dry land" machine should be used. Of course, it is possible in some cases to vary the elevation of the water surface up or down. In this way it is possible often to use only one type of machine on a piece of work otherwise requiring two. Then, too, the records must be consulted or the local inhabitants questioned as to flood conditions and the water-level at different seasons of the year. A dry land machine under water is worse than useless. The raising of the water-level in a large district is apt to be disastrous in the case of a large storm by cutting down the storage capacity of the watercourses.

If the excavation is to be done by a hydraulic dredge or by hydraulic monitors, the quantity of water available must be looked into very carefully.

If steam shovels are to be used, a good supply of good water for boiler purposes must be on hand. In case of doubt it is well to have the water sampled before counting definitely on its use.

The type of machine best suited for the work may be selected from the large variety available, after a careful consideration of all the points to be considered.

Floating Equipment

If floating equipment has to be used, it would be the dipper dredge, ladder or bucket dredge, clam-shell dredge, hydraulic dredge or some form of dry land machine mounted on a hull. Where the material has to be deposited some distance from the point of excavation, a dipper or ladder dredge for digging may be used in combination with a hydraulic dredge or dredge parts for hydraulic disposal. The material may also be placed in dump scows or on the deck of flat-deck barges by a dipper dredge or ladder dredge or the dry land machine on a hull. Dump scows may be used except where the spoil area comes up near to or above the water surface. Flat-deck barges should be used where the material will be scraped or picked up from the deck of the barge by a dragline

clam-shell or orange-peel bucket. If the material were deposited in the bottom of the barge, the bucket would damage the hull and cause it to leak.

If blasted rock is being dug below water, the dipper dredge or a very large grapple operated by a clam-shell dredge should be used.

If the work covers a very large area, is fairly easy digging and has very little depth to be removed, a ladder dredge is very suitable. The ladder dredge delivers its dredged material alongside the dredge, close to the hull and rather low down. Barges being loaded can be moored to the dredge and worked fore and aft for loading. Where the ladder dredge cuts its own flotation in a narrow channel, it swings on spuds, but where there is width sufficient, it travels back and forth across the cut on mooring lines.

The dipper dredge may be equipped with a long, short, or standard length of boom, thereby regulating the radius at which the bucket or dipper may be dumped. The barges have to be held well forward and loaded, first one end of the barges turned, and then the other end. For very deep digging, the dipper dredge is preferable on account of the very heavy ladder and buckets on the ladder dredge.

For very deep digging, the clam-shell dredge is best of all, unless the material is hard. With this dredge, the only difference required in the dredge for shallow and for deep digging is the length of the two ropes leading from the drums on the dredge over the point of boom sheaves and down to the bucket. The barges are placed for the clam-shell dredge as for the dipper dredge. The dipper dredge is a much stronger, harder digger than the clam-shell. The dipper dredge always works on spuds; the clam-shell may be moored by spuds or by lines to anchors. The boom of the clam-shell dredge is much lighter than the boom of the dipper dredge, and of course there is no dipper handle, so that the same hull will allow of a longer boom when rigged and used as a clam-shell dredge than as a dipper dredge.

Where the material dredged has to be deposited at a greater distance than can be reached by a boom, the hydraulic dredge on a large piece of work will transport silt, soil, mud, sand, gravel, cobble, some forms of clay, and a small proportion of boulders, with a very low labor charge and fairly high fuel and repair charges.

The hydraulic dredge is not suitable for large quantities of boulders, forms of clay which will ball up enough to clog the discharge pipe, or flat stones which will not roll along the pipe. The distance to which material may be pumped is almost unlimited, depending upon the number of pumps used in the pipe line as relays at suitable intervals.

A dragline machine may be mounted on a hull and used either with a dragline bucket or a clam-shell bucket. The machine is located preferably at the exact center of the hull, thus giving an even keel and the proper trim. The only unbalanced weight would be half of the load of excavated material in the bucket at the point of the boom, as the weight of the boom, bucket, and half the load are counterbalanced exactly by the weight of the rear end of the revolving frame of the dragline machine. Such a machine has the advantage of being able to dig or dump at any point in the 360-degree arc described by the point of the boom. With a dragline bucket, the digging area would be increased by dragging the bucket toward the machine.

The clam-shell bucket will dig a channel in front of the hull, to provide draft for the hull, better than the dragline bucket, which forms a roll or ridge of material between the cut made by the bucket and the cut in which the hull is floating. Such a hull may be equipped with spuds or moored by lines to anchors.

There is still another method which can be employed for digging material under water. If the conditions are right for a tower excavator, where the tower is located on one bank or shore line and the other end of the track cable is anchored in the water or on the opposite bank, the track cable spans the water and carries the drag bucket. Also, a cableway may be used with two towers and a clam-shell bucket. In both cases, where the track cable spans the water, it must also span sufficient spoil area to take out all of the material the machine can dig without moving the machine.

Where the original ground level is above the water surface, a dragline can stand on the dry land and dig material from below the water surface.

Dry Land Work

Dry land work may be done with a heavy two-truck shovel, a revolving shovel, a dragline, a scraper type of machine, a tower machine, or by hydraulic monitors. The two-truck shovel is for the very hard digging of blasted rock where the material is to be loaded into cars and hauled away. The revolving shovel can be used to advantage in loading horse-drawn wagons, and the largest sizes of revolving shovels are being used in stripping operations with great success. In these operations the shovel is used generally to "overcast" or dig material from the bank on one side and deposit it on the other. In the deep deposits of iron ore, they are used for loading cars situated at a considerable elevation above the machine tracks.

While a steam shovel does its digging to best advantage in front of the shovel and above the ground on which the shovel stands, the dragline digs behind itself and below the surface on which the machine stands. The shovel stands down in the excavation; the dragline stands on the edge of the hole being excavated. A steam shovel prepares its own path in the actual excavating. A dragline has to stop excavating to prepare its path.

The scraper type of machine has a boom which may be held horizontal and a bucket pulled along the boom, guided in a straight line by the boom from the machine to the point of the boom. Some of these machines swing the boom only; others are full-swing. The dumping is done by raising the boom, swinging over a car and allowing the front end of the bucket to drop. They are useful for skimming or for

cleaning-up work and are in use for coal stripping work and for picking up coal which has been shaken up a little by blasting.

The hydraulic monitor can be used for digging and transporting material under certain favorable conditions.

All the machines referred to above are described in more detail in Mr. Massey's book, "The Engineering of Excavation."

Size of Machine

The size of machine to be used depends upon the power required for digging, the distance from digging point to disposal point, the total yardage to be handled, the time available, and the location of the work as regards railroads, roads or water navigation. In the case of machines for subaqueous work, the depth of the digging makes a great difference, except in the case of the clam-shell dredge.

In some cases, owing to the difficulty of transporting to the job and from the job a large, efficient machine for a piece of work, it has been decided to use a smaller machine at a considerably higher cost per cubic yard for excavation, but not enough higher to equal the extra charge per cubic yard for the extra expense of bringing in the large machine.

Fuels

The fuels which are available for excavating machines are wood, coal, fuel oil, distillate, kerosene and gasoline. Wood requires a large gang of men to cut and handle it. It also requires a large fire-door high up in the fire-box and quite a deep fire-box, so that the wood on the top of the fire may be thoroughly dried before it is required to be burned and furnish heat. Coal is used most. Fuel oil is not crude oil, but is crude oil from which the distillates have all been removed. The application of adequate fire brick arches, oil tanks, burners, heaters, etc., to a coal-burning boiler will convert it into an oil-burning one. The arches must be designed especially for each type and size of boiler. The distillates are heavier than gasoline and kerosene and are used in the hot bulb or semi-Diesel engines. Other types of engines will run on distillate or kerosene after starting on gasoline. Oil fuels are usually the least expensive in transporting, but high in first cost. The relative costs of different fuels should be figured to the boiler door or to the engine, so as to include all labor charges.

Saving Time on the Job

All excavating machines will do a certain amount of work at one setting. After this, the machine has to stop work and be moved to another point. This moving time is lost time, and it is desirable to keep down the moving time as compared with the digging time. This is all in favor of a small machine on the work rather than a large one. It also means that on the same job, the larger the machine, the quicker should its moves be made. The reverse is usually the case.

Transportation often costs more per cubic yard than excavation. This may be due to length of haul, insufficient rolling stock, too small locomotives, too light rails, ties spaced too far apart, false economy in cutting down track repair expenses, poor layouts of tracks with excessive grades against loaded trains, or sharp curves and poorly located switches. Often standard-gage, 4 feet, 8½ inches equipment would be far better than the 3-foot narrow-gage equipment.

It often happens that special appliances can be adapted to a machine so as to cut out the labor of a man here and there. Thus electric jackarms have been applied to an electric shovel, machines laying their own track eliminate four ground men or pit men, a small belt conveyor for coal on a dredge, or a coal hoist on a big dragline or revolving shovel, will save labor in stacking coal aboard. Power-driven spuds obviate the services of a deck-hand. Deck winches for handling scows reduce time and expense.

Obstructions and Delays

It is usual to have an excavating job complicated by obstructions to the passage of the machine while engaged in the work. Some of these obstructions are: power lines, trolley lines, railroads, electric roads, highways, lack of right-of-way, bridges, watercourses, pipe lines and standing timber. Any of these may require partial dismantling of the machine. They usually involve expense in removing and replacing and often make it necessary to do a considerable amount of excavation at a much higher unit cost in the immediate vicinity of the obstruction. Sometimes the right of way for the work and the spoil area are not sufficient, requiring extra care or slowing down of the work to keep within the right of way provided.

If there are unusual flood conditions likely to occur without much warning, it is necessary to have a place already provided where the machine can be protected from high water or swift currents.

Under certain favorable conditions, emergency excavation can be done by blasting. It has the advantage of requiring no plant and the minimum of time.

ACKNOWLEDGMENT.—Printed through the courtesy of George B. Massey and John Wiley & Sons, Inc., New York City.

Properties of a Good Wood Preservative

TO prevent fungus infection, the preservative must be able to penetrate the wood thoroughly enough to form a continuous exterior shell of poisonous treated wood deeper than any surface checks which are likely to develop, and to retain its toxicity, or poisoning power, under service conditions. Safety in handling and use is another important consideration.

—*Wood Preserving News.*

Seasonal Unemployment in Building Trades

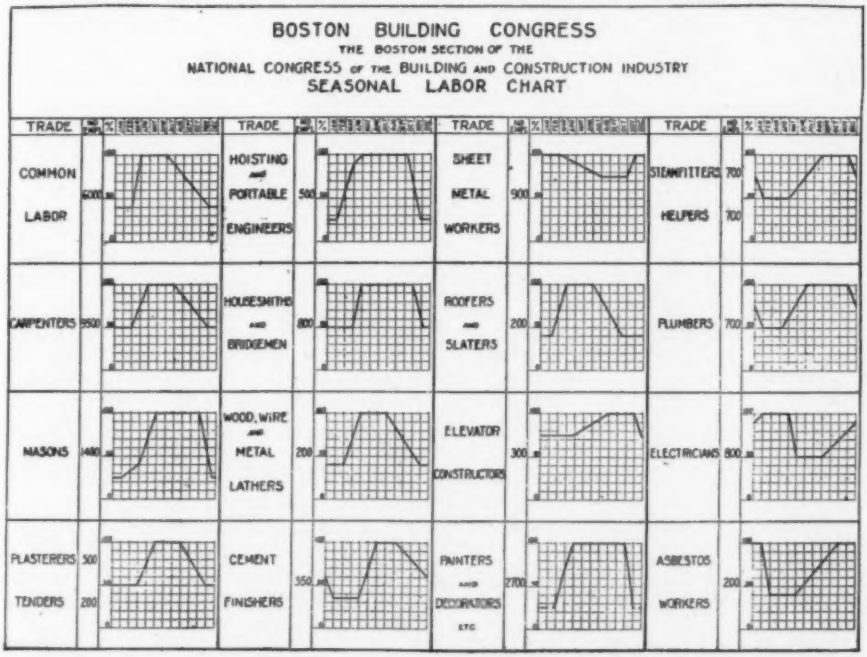
Results of Interesting Study Shown Graphically

THE Boston Building Congress has prepared the chart shown below, indicating the seasonal employment of labor in the building construction industry. It has issued a plea to owners and managers of property not to neglect the question of seasonal unemployment, especially in repair work, as such neglect costs money and causes trouble.

The diagrams below indicate that the average workman is out of employment 25 per cent of each year. This means that many men in most trades are unemployed from 50 to 75 per cent of the time. This is caused by the concentration of demand in certain periods, which is largely due to weather conditions that can be overcome only in part and with difficulty. It is partly due to the fact that owners demand that many items of repair work be attended to just at the time when weather conditions have already created a maximum demand for labor. Much of this work can just as well be done at other times, if the owner will only study this chart and arrange to have his repair work done during the low peak of employment in that trade. He will thus secure better mechanics, better work and better prices in competition.

By giving a little thought to this petition, the owner will help to reduce the surplus of mechanics that labor has to recruit to take care of the high-peak demand, many of whom are employed for only a short period each year and are therefore not highly skilled in their trade. This creates a natural tendency for higher wages to make up for lack of wages during periods of unemployment. The Boston Building Congress suggests that roofing jobs, including conductor and gutter repairs, be handled, if possible, in September, October and November; interior painting from December to April; alterations and additions to plumbing from January to May; heating overhauling and repairs as soon as the plant is shut down in the spring, with the planning of major repairs and replacements of heating plants during the winter, so that work can be started by April 1. Electric fans, motor and other equipment should be overhauled from September 1 to January 1; masonry, carpentry, plastering and lathing and other miscellaneous interior remodeling from December 1 to April 1.

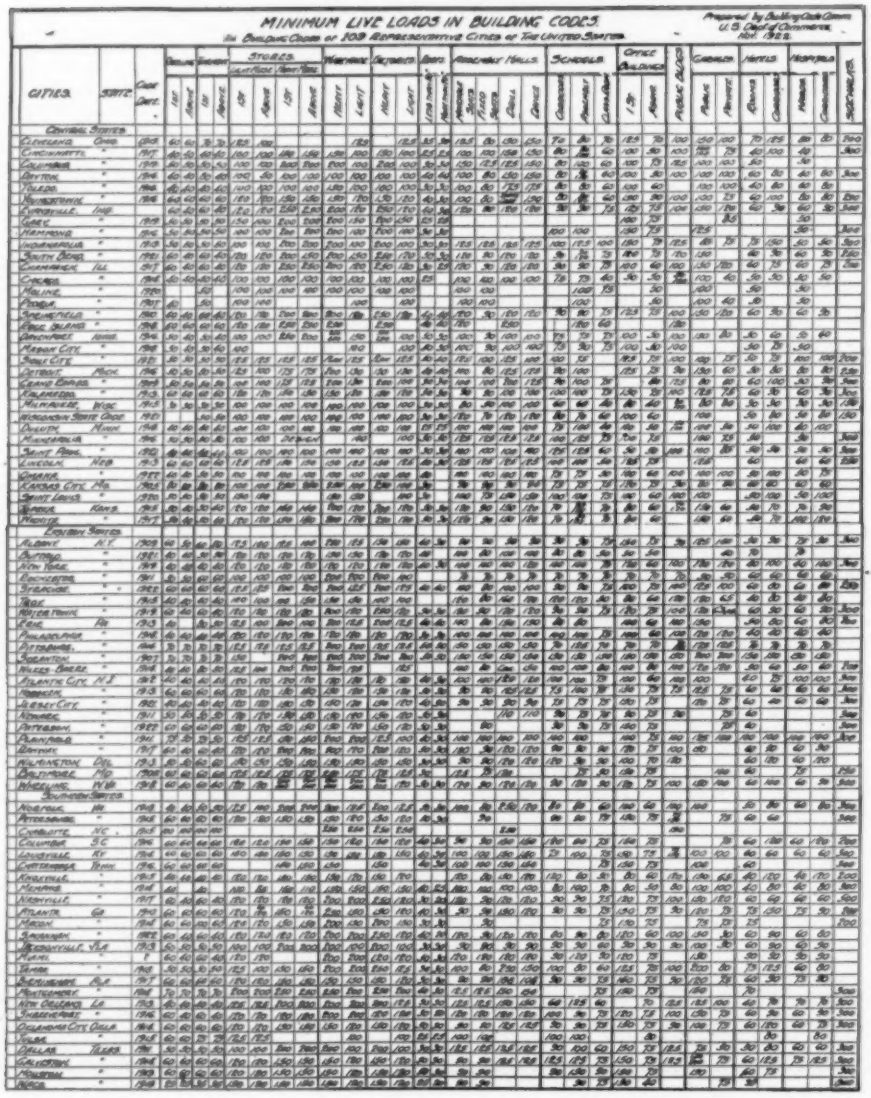
Attention is called to the fact that this applies equally to the small householder and to large property owners. They should not try to buy building labor when it is scarce, but buy it when it is plentiful, as any other com-



modity would be purchased, thus securing better quality of work for lower cost.

The circular from which this statement was prepared and the charts reproduced, is endorsed by the Master Builders Association, the Heating and Piping Contractors Boston Association, the Boston Real Estate Exchange, the Building Trades Employers Association, the Boston Chamber of Commerce, the American Building Trades Council, and the Boston Society of Architects, and is issued by the Boston Building Congress, composed of representatives of all the elements of the building industry, including building investment, architects, engineers, contractors, subcontractors, labor and material men, united for the purpose of improving conditions in the industry and making it capable of better service.

A Study of Building Codes


MINIMUM LIVE LOADS IN BUILDING CODES.
In Building Codes of 109 Representative Cities of The United States.
Prepared by Building Code Comm. U.S. Dept. of Commerce, Nov. 1922.

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CITIES.	State	Code Date.	Dwellings	Tenements	Stores: Light Manufacturing	Stores: Heavy Manufacturing	Warehouses	Factories	Barns	Armories and Halls: Assembly Rooms	Armories and Halls: Fixed Seats	Armories and Halls: Stage	Armories and Halls: Gallery	Armories and Halls: Dance	Schools: Classrooms	Schools: Assembly Rooms	Schools: Corridors	Office Buildings: 1st	Office Buildings: Above	Public Buildings	Garages: Public Rooms	Garages: Private	Hotels: Rooms	Hotels: Public Rooms	Hospitals: Rooms	Hospitals: Wards	Hospitals: Corridors	Sidewalks.
			1st	Above	1st	Above	1st	Above	Heavy	Light	Heavy	Light	Loft Workers	Assembly Rooms	Fixed Seats	Stage	Gallery	Dance	Classrooms	Assembly Rooms	Corridors	1st	Above	Public Rooms	Private	Rooms	Wards	Corridors	
New England.			Live Load Requirements in Pounds per Square Foot.																									
Worcester,	N.H.	1918	50	30	50	40	125	100	200	100				40	40	100	70	100	50	100	100	100	70	60	100	100	70	100
Boston,	Mass.	1918	50	30	50	40	125	125	250	150	250	125	125	60	50	100	100	100	100	75	100	70	100	100	75	70	100	100
Cambridge,	"	1917	50	30	50	40	125	75	150	125	250	150	150	150	125	100	100	100	100	100	100	50	125	75	100	100	75	100
Haverhill,	"	1913	40	30	50	50	125	125	125	125	Steel Beams	Slightly Less	40	40	150	125	100	100	100	100	100	50	125	75	100	100	75	100
Lowell,	"	1916	40		50		100		200		250	150	200	100	40	40	150	125	125	50	75	125	50	100	100		50	100
Lynn,	"	1916	50	50	50	50	125	125	Plans Examined				125	40			150	125	100	50	75	125	50	100	100	125	50	100
Springfield,	"	1917	40	40	40	40	125	125	125	125	200		125	125	40		125	60	100	100	100	125	100	100	100	125	100	100
Worcester,	"	1917	60	40	60	40	125	125	200	150	250	150	125	50	50	100	125		125		75		125	75		100	75	
Cranston,	R.I.	1918	60	60	60	60	120	120	150	120	150	120	150	150	50		100	100		75	100	50	120	75		100	60	
Providence,	"	1917	50	30	50	30	125	125	150	150	250	150	150	150	60		125	125	100	100	125	100	125	75	125	150	100	125
Bridgeport,	Conn.	1915	50	30	50	50	125	100	200		200	125	125	125	40	40	100	100	100	50	75	75	100	60	100	100	75	100
Hartford,	"	1913	60	60	60	60	125				250	150	200	125	50	50	100	100	100	100	100	50	60	50		100	60	100
New Haven,	"	1913	50	30	50	30	125	125	150	125		150		125	50	50	100	100	100	75	100	50	100	50		100	75	100
Stamford,	"	1917	50	50	50	50	125	100	200	150	200	150	150	150	40	40	100	50		100	100	75	100	60	100			
Western States.																												
Butte,	Mont.	1917	50	30	50	40	150	150	150	150	250	250	250	150	50		150	150	150	150	150	150	150	150	150	150	80	150
Cheyenne,	Wyo.	1917	40	40	40	40	150		200		300		200	200			150	150	150	150	150	75	60	60	150	200	100	150
Evanston,	"	1917	60	60	60	60	150	150	150	150	150	150	150	150	60	60	150	150	150	150		75					50	150
Ogden,	Utah	1918	60	60	60	60	150	150	250	250	250		250		60	60	125		125			75	125				60	125
Salt Lake City,	"	1917	60	60	60	60	125	125	250	250	250	250	250	125	50	50	125	125	125	125	125	75	125	60	125	125	60	125
Ventura,	Cal.	1917	50	40	50	40	150	150	150	150	250	150	150	150	50	50	125	125	125	100	125	75	125	75	125	125	60	125
Los Angeles	Calif.	1915	50	30	50	30	125	125	125	125	150	125	150	150	50	50	125	125	125	100	125	125	125	75	125	150	50	150
Oakland,	"	1917	50	40	50	40	150	150	150	150	150	150	150	150	50	50	125	125	125	125	125	75	125	60	125	125	60	125
San Diego,	"	1917	50	30	50	40	150	150	150	150	150	150	150	150	50	50	125	125	125	100	125	75	125	60	125	125	60	125
San Francisco,	"	1916	60	60	60	60	125	125	250	250	250	250	250	125	50	50	125	125	125	125	125	75	125	60	125	125	60	125
Portland,	Ore.	1915	50	50	50	50	125	125	150	150	250	150	150	150	50	50	125	125	125	100	125	75	125	60	125	125	60	125
Seattle,	Wash.	1917	50	40	50	40	150	150	150	150	250	150	150	150	50	50	125	125	125	100	125	75	125	60	125	125	60	125
Spokane,	"	1918	50	40	50	40	150	150	150	150	250	150	150	150	50	50	125	125	125	100	125	75	125	60	125	125	60	125
Tacoma,	"	1917	50	40	50	40	150	150	150	150	250	150	150	150	50	50	125	125	125	100	125	75	125	60	125	125	60	125
Municipal Requirement			50	30	50	30	125	100	200	100	200	100	100	100	50	50	100	100	100	100	100	50	100	50	100	100	50	100
Maximum	"		60	60	60	60	150	150	250	250	450	450	450	450	60	60	150	150	150	150	150	150	150	150	150	150	150	150
Number Listed (for Average)			107	107	107	107	107	107	50	50	50	50	51	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103
Average.			52	35	52	40	128	115	182	126	236	184	177	170	128	128	114	112	112	95	102	62	102	83	116	73	57	117

MINIMUM FLOOR LOAD REQUIREMENTS ALLOWED AS A BASIS OF STRUCTURAL DESIGN IN THE UNITED STATES.

Analysis of Building Code Requirements of 109 Representative Cities of the U.S. showing number in which each of the following Minimum Loadings are Specified for the Occupancies listed.

U.S. Dept. of Commerce. Building Code Comm. Dec. 1922

Minimum Load in Pounds per Square Foot.

Occupancy	Average	Average Load	20	25	30	35	40	50	60	62½	65	70	75	80	85	90	100	105	110	112½	115	120	125	130	140	145	150	160	175	180	200	250	300	400	500
Dwellings 1st. Floor.	107	43.0		1	2		78	31	38			3	1	5			1																		
Above.	103	43.1		1	2		40	25	26			3		2			1																		
Tenements 1st Floor.	109	48.0			1	1	21	32	37			6	2	8		1	2																		
Above.	105	50.0			1	1	37	33	25			6	1	5			1																		
Stores Light. 1st. Floor.	107	118.0												1			86						41	29			9			1					
" Above.	102	115.0						1					1	1		1	36						39	18			6			1					
Heavy 1st. Floor.	38	162.0															12						12	6		1	3	1	3	2	11	1			
" Above.	36	136.0														1	13		1				11	7		1	30		2	1	18	9	1			
Warehouses Heavy.	39	186.0															8						8	1			28				39	16	1	1	
Light.	100	137.0															82						29	14	2		16		2		12	3	1		
Factories Heavy	97	177.0															10						8	3	1		28		1		25	26	1		
Light.	103	121.0															27						31	25	1		10				2	1			
Roofs Less than 20°	100	39.0		6	24	1	40	27																											
More than 20°.	88	31.0	1	9	66		12	4																											
Assembly Movable Seats	102	100.0										1		1		14	39						22	20			6								
Halls Fixed Seats.	102	96.0						1	1			2	8	25		39	22						3	14			3								
Drill Halls.	39	137.0										1				4	17			1	1		7	13			27	1	1		3	7			
Dance Halls.	36	115.0										1				4	18			1	1		16	14			23		1		2	1			
Schools Corridors.	96	92.0						1	3			7	13	11		16	18							7			3								
Assembly.	101	98.0							1			2	12	7		26	29	3				1	1	15			4								
Class Rooms	96	65.0					3	10	21	1		9	41	3		3	1							1			1								
Office Buildings 1st E.	101	146.0						1	1			3		8		8	30						12	14			27								
Above.	108	63.0					6	14	22			6	60	3		2	4										2								
Public Buildings.	80	105.0						1				1	3	1		9	37					2		6	14		3								
Garages Public.	90	126.0						1					2	3	1		26							8	11	1	1	30		2	3					
Private.	80	72.0			1		3	4	3		2		26	7	1		18							8	3			1			2				
Hotels. Rooms	106	59.0			1	1	18	30	40		1	4	7	1		1	2											1							
Corridors	88	97.0					5	9	8			5	7	13		17	14							6	7			3							
Hospitals. Wards.	76	61.0			1		13	24	35			4	7	4		7	4							1	1			1							
Corridors	54	83.0			1		5	4	10			2	4	16		26	11							3	5			1							
Side Walks.	63	577.0																										4			3	9	46		1

Overhead---Administrative, Field, and Invisible

Disregard for Contractor's Overhead Leads but to Bankruptcy

WHEN a contractor has completed his estimate, and after the costs have been totaled, a certain percentage for overhead should be allowed. This is sometimes called "the cost of doing business." The percentage is calculated in various ways, but it is usually determined by each contractor according to the size of his operations and personal efforts.

Administrative Overhead

Administrative overhead is that expense which cannot be directly charged to a project or a job, and should be divided into two classes —fixed office expense and miscellaneous expense. Fixed office expense consists of salary to executives (meaning that the builder should put himself on the pay-roll), estimators and clerks, rents, plant depreciation, furniture and fixture depreciation, interest on equipment, cost keeping and the helpers involved therein, bookkeeping and its involved cost, yard men and tool men. Miscellaneous expense is, of course, invisible, and is usually composed of stationery, bill-heads, advertising, interest on borrowed money, office supplies, telephone, telegrams, postage, business travel, automobile upkeep, taxi fares, charity, business insurance, legal expense, tool and equipment maintenance, team accounts, etc.

Field Overhead

Field overhead should also be divided into two classes—non-productive labor and its kindred expense, and such invisible overhead as accrues on the job whether or no. Sometimes it cannot be avoided, no matter how much effort the builder may put forth to stop it.

The first class of field overhead or non-productive field labor overhead is made up of superintendents' salaries, or wages for the timekeepers and material clerks, also the expense of equipment rentals, setting up equipment, removing and putting equipment in good order and hauling it back to the yard, temporary offices, tool sheds, cement sheds, temporary power and light, temporary enclosures and fences, sidewalk protection, water connection, tarpaulins, machinery protection equipment, hauling, etc. Offices, sheds, etc., should be considered costs.

Invisible overhead arises on a job or project and is very often incurred by negligence, sometimes sabotage. More often the best efforts cannot prevent it, and it should be taken into consideration when making up an estimate.

Lost Time

Lost time is the bottomless pit into which more money than can be estimated has been dumped by contractors. A day free from delays will produce twice as much as an average day. To attain the ideal protection, needs cost keeping and system—hence, overhead. Invisible overhead is usually composed of the following items: interference of inclement weather, time lost by breakdowns, time lost by shifting plant, time lost by waiting for other parts of the project to be made ready, time lost by waiting for material, time lost by shifting men to other jobs, efficiency lost by putting on new men, crews too small to be effective in relation to superintendents, foremen, etc. This last item was the case with a certain bricklaying and plastering situation last summer. The builder often had his foremen working with two or three bricklayers and as many laborers. Could he have obtained 20 bricklayers, his overhead would have been the same per day. The importance of including the invisible expense in the estimate as a contingency or overhead is readily apparent.

Making Up Overhead

The making up of overhead is, of course, not alike in every office, but if the gross expense for the year, including the contractor's own salary, is $15,000 and the business amounts to $300,000 a year, evidently the overhead is 5 per cent. There are a number of books of more or less value written on the subject of cost keeping systems. On construction work, nevertheless, the builder frequently neglects the opportunity of familiarizing himself with and studying the systems offered, and will continue his lamentations over unfair competition and his complaints about the contracting business being the worst business on earth to use up men and money.

Taking the first step in system is to map out the object desired and also to map out the results to be obtained, and preferably always on paper. It is astonishing what cold figures on paper will analyse after a job has been completed. System includes the keeping of records and costs, such as bookkeeping, filing systems, and estimating. The contractor sometimes objects to a system and calls it red tape, but somehow the operators who have surrounded themselves with red tape do not seem to make assignments in bankruptcy as often as the man who will have none of it. The small contractor objects to system because it takes up so much of his time. If the small contractor's business has grown to such an extent that he must work more than 10 hours to keep abreast of his work, then it is absolutely necessary to him to acquire some help, so that he may keep his business records correctly as to income and outgo of money, the records of his banking account, the condition of his equipment and tools, etc. He then at once acquires overhead in addition to his own salary. As to what his salary should be, his competitor, his conscience and his avariciousness will have to be his guide.

Subcontractors' Overhead

The overhead of the general contractor, discussed above, is, of course, considerably less than the overhead of the plumbing or painting contractor. The average overhead of the painting contractor is approximately 20 per cent, consisting of the usual fixed expenses and miscellaneous expenses, uses and depreciation of brushes, paint-pots, step-ladders, drop-cloths, jack-ladders, small cloths, auto trucks, etc. It has been found that 22½ per cent is an average overhead for the plumber, and it ranges from 18 to 20 per cent in small establishments where the proprietor puts in his time in the evenings, making out calculations, bills, rent and such other items as the use of tools.

ACKNOWLEDGMENT.—From an address delivered by Gerhart F. Meyne, Vice-President, Associated Building Contractors of Illinois, before the convention of that association.

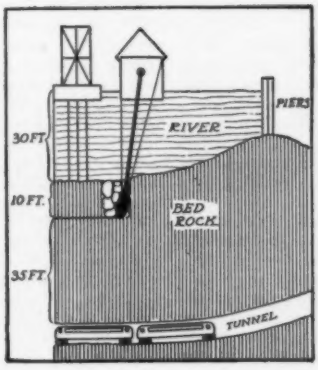
Ripping Up Diamond Reef with Dynamite

Deepening the Channel in East River Over Subway Tubes Is a Job Without Precedent in Harbor Engineering

VISUALIZE a map of New York City. Imagine yourself standing at the southernmost point on Manhattan Island at the eastern side of Battery Park where you can look up the East River and get a good view of the Brooklyn Bridge. Let your mind's eye focus on the river itself, and you will see two curious-looking boats anchored somewhere between the bridge and the place where we have asked you to stand. Those boats are making engineering history, too.

Before we get to that, it is necessary to explain that two subway tubes connecting Manhattan and Brooklyn extend under the river bed, and the position of the drill and dredge boats illustrated here gives you some idea of their general location. One of them is called the Brooklyn Rapid Transit or Montague Street tunnel. Through it, subway trains roar back and forth between Whitehall Street, Manhattan, and Court Street, Brooklyn. The other is called the Clark Street tunnel, maintained by the Interboro System. Hundreds of thousands of people ride to and from work daily through these tubes—and probably not one in a hundred knows that blasting operations in the rock above the tube are an every-day occurrence.

The reason for that, too, needs explanation. The ship channel in the East River isn't deep enough. Thirty feet of water was ample in days gone by, but not now, when 10 feet more of depth is necessary to accommodate the largest freight ships and war craft. The big handicap to making the channel deeper is the Diamond Reef, which is an exceedingly hard rock formation jutting up in the river bed. Cutting the channel to a 40-foot depth thus involves what amounts to under-water rock-quarrying with the added complication that considerable rock must be excavated *directly over* the subway tubes. So far as we know, it is the first time in the history of harbor engineering that a situation of this kind has been encountered; and it is certain that on no Government undertaking of the kind has it been necessary to take such elaborate safety precautions as are effectively carried out each day by those in charge of the operation.



The New Jersey Shipbuilding and Dredging Company of Bayonne, N. J., is doing the work. Incidentally, this concern has done a great deal of important work in the East River. In 1886, to cite one instance, this concern very largely assisted in blowing up Hell Gate and in opening up a passageway for boats of large size to come through the channel. Just what the company is doing to Diamond Reef is illustrated by the cross-section diagram on this page. It gives you a clear-cut idea of where and how the drill boat, dredge boat and du Pont dynamite are together cutting, blasting and removing the solid rock without endangering the lives of those who ride each day on the tube trains.

The drill boat works constantly. It is a floating platform supporting three drill frames, a big steam boiler, and a superstructure housing the crew and machinery. On these drill frames, about 20 feet above the water, are the little engines that operate the drills. Thirty feet below the water-level these drills, spaced 10 feet apart, twist and bore into the solid rock to a depth of 10 feet. When the holes are bored and the tide is right, charges of 80 and 90 per cent du Pont gelatin are packed into lengths of galvanized iron leader pipe and lowered into the holes; then it is only a moment's work to make the wires leading to the charge ready for service. The drill boat moves away about 75 feet, riding on her anchor chains,

and the preparatory work is done.

Then the shot-firer takes his station and turns his eyes shoreward. He signals that he is ready. An inspector on the pier raises a red flag, indicating that he has seen the signal and that his assistant is telephoning the Brooklyn Rapid Transit train dispatcher. The telephone wire remains open as the dispatcher watches the little green signal lights flickering across the lines which represent the tunnel. Each flash progressively shows the progress of the trains as they pass the block signals. He holds up other trains from entering the tunnel. Then, as the last green light fades, showing that the tunnel has been cleared of all trains, he gives the word by 'phone to the inspector's assistant.

THE DREDGE AT WORK AT DIAMOND REEF

Down goes the flag. The shot-firer quickly sends the electric current through the wires to the charge, and the force of 100 pounds of dynamite is released. Forty feet below, the rock has been shattered, but there is so little disturbance of the water at the surface that unless someone were to point out a circle of foam surging up from the bottom, it would likely escape your notice. A few seconds later and it's gone. The people on Brooklyn Heights occasionally feel a slight tremor as a charge goes off, but that's all. Within another ten seconds the impatient subway trains are rushing through the tunnel again, the dredge edges up to do its work, and the drill boat goes back to put down another row of holes.

Speaking of the blasting, Charles D. Pullen, Vice-President of the dredging company, is quoted as saying: "We push the rock apart. We do not attempt to blow the reef up. The charge cracks the reef. Then the dipper goes down and lifts the boulders slipped off from the parent rock up into the scow. When filled, the scow is towed away, and that's really all there is to it, except that it takes a lot of planning, a lot of figuring, and a lot of money."

Even though the blasts are being set off directly over the tubes, with only 35 feet of solid rock intervening, the shock of an exploding charge can scarcely be felt inside the tube. Before the first blast was made over the Clark Street tunnel, officials went inside to note its effect. It is said that as the charge went off, "the surface of a glass of water placed on the floor of the tube shook ever so slightly." It was a reassuring test.

So much rock must be excavated that this work will probably continue into next year before it is completed.

ACKNOWLEDGMENT.—Text and illustrations by courtesy of *The Du Pont Magazine*.

The Value of Responsible Surety Companies

CONTRACTORS who patronize irresponsible surety companies for the sake of rebates are permanently injuring their own profession and their personal businesses, according to a statement recently issued by William B. Joyce, Chairman, The National Surety Company, New York City. He believes that irresponsible contractors whose continued business activities are made possible largely by the financial credit which they receive from surety bonds, obtain these bonds only from the inferior rebate-giving class of surety companies.

Reputable contractors and reputable surety companies should get together for a combined clean-up in both professions. After 33 years of suretyship for contractors, Mr. Joyce states that he feels that the evils of surety bond rebating and irresponsible contracting are directly interdependent. If reputable contractors would refuse to patronize inferior surety companies for the sake of rebates, these companies would gradually go out of business, and as soon as irresponsible surety companies are forced out of business, irresponsible contractors will be unable to obtain surety bonds—the financial credit of which is the only thing that at present keeps them alive.

Mr. Joyce says, "I have watched the operation of this interdependence between the lower elements of both professions for many years. Very regretfully, I have also watched reputable contractors while directly assailing the irresponsible element in their own profession ignorantly perpetuate this element by patronizing the irresponsible surety company, which keeps it alive with rebating surety bonds. I have protested for years against the interdependent evil in these two honest and useful national professions. But many reputable contractors still, apparently, are blinded to its viciousness."

The Construction of the Sunnyside Distributing Reservoir, Salt Lake City, Utah

By Sylvester Q. Cannon
City Engineer, Salt Lake City, Utah

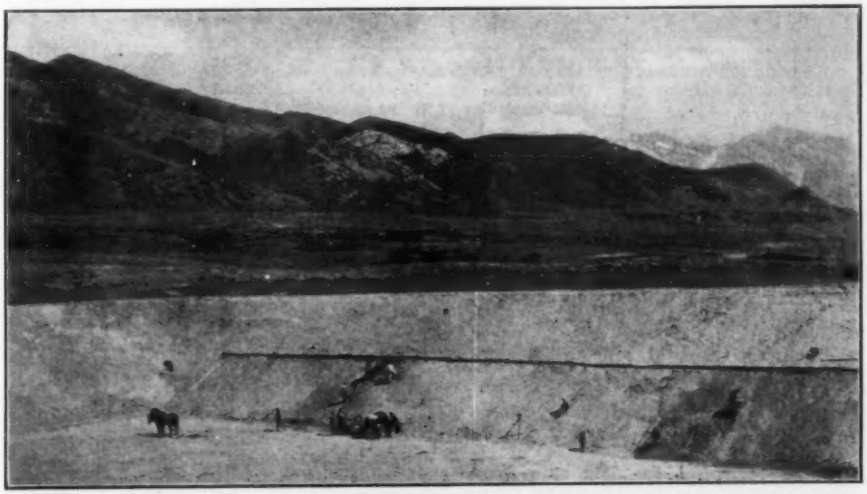
IN 1920, Salt Lake City built a reinforced concrete gravity supply conduit, known as the Parley's High Line conduit, of 48-inch lock joint pipe having a discharge capacity of 40 million gallons per day. This conduit led from the end of the Big Cottonwood conduit at the mouth of Parley's Canyon to a point just south of the mouth of Emigration Canyon, a distance of about 3 1/3 miles.

The terminus of this gravity supply line is on a tract of ground owned by the city near the foothills of the Wasatch Range. At this point the gravity conduit connects with a cast iron pressure main of 36-inch diameter, known as the Sunnyside Avenue pressure main, which leads westerly and northwesterly to connect with various points on the distributing system.

In order to equalize the supply and the draft of water at this point, provision was made at the time of the construction of these pipe lines whereby three 10-million-gallon distributing reservoirs can be built on this tract, as conditions may justify.

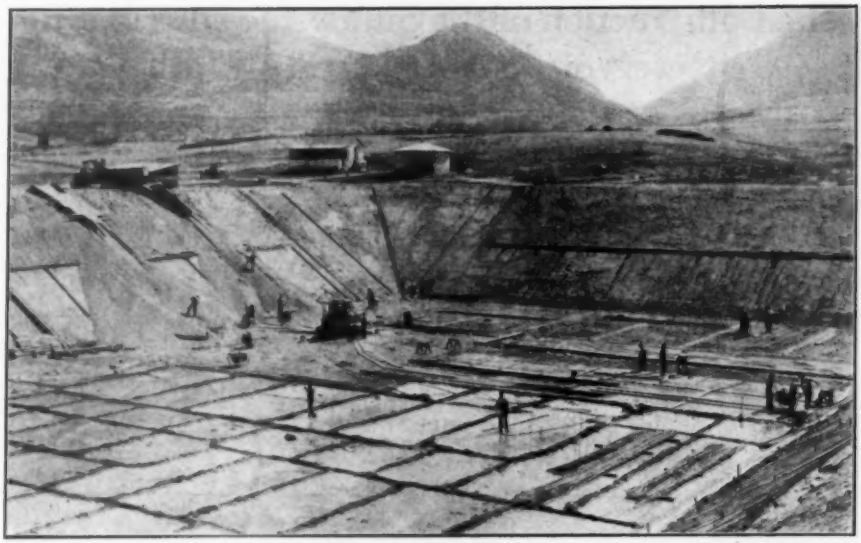
That water may be conserved at this point and a constant supply maintained to the pressure main, an equalizing reservoir became highly necessary. Water was being wasted because of the impossibility of regulating the gravity conduit to exactly supply the pressure line. To this end, the construction of the first unit, known as the Sunnyside Distributing Reservoir, was undertaken.

During the late summer and fall of 1921 the employment situation locally was anything but satisfactory. It was therefore decided by the Board of Commissioners of this city, as one of the means that might be used to alleviate unemployment, to begin the work of construction of this reservoir to the extent of doing the excavation and building the embankments during the winter season. This could very well be carried forward during this season of the year and thus help to remedy the general slackness of employment among common labor.



LOOKING SOUTHEASTERLY ACROSS SUNNYSIDE RESERVOIR, SHOWING CONTRACTOR'S MEN TRIMMING SLOPE PREPARATORY TO CONCRETING

Besides, by building the embankments during this season of the year, it was felt that, in addition to the compacting of the embankments in construction work, the spring rains and the allowing of ample time before placing concrete lining would permit the embankment to thoroughly settle and thus avoid cracking the concrete lining. Consequently, the Engineering Department was authorized to proceed with the preparation of plans which were crowded forward for the excavation, etc., in order to get the work started as early as possible.



LOOKING NORTHEASTERLY ACROSS SUNNYSIDE RESERVOIR, SHOWING CURING OF CONCRETE BY PONDING IN FOREGROUND, THE PLACING OF CONCRETE AND SETTING OF REINFORCEMENT IN BACKGROUND

Location and Dimensions

The site for this reservoir is, as stated, near the foothills of the Wasatch Range just south of Emigration Canyon on a tract of ground sloping gently toward the west. The elevation of the water surface of this basin when completed will be 584 feet above the mean elevation of the business district of the city and about 4 miles easterly from it. The basin is 295 feet long east and west on top, and 205 feet long on the bottom, 230 feet wide on top, and 140 feet wide on the bottom. It is 30 feet deep, with slopes of 1½ to 1. The slope toward the west is such that the east side of the reservoir is entirely in cut, while the west side is slightly more than half embankment.

Excavation and Embankment

With these purposes in view, bids were received on December 15, 1921, for the excavating of the basin and the placing of the embankment. Our estimate of the cost of this work, based upon the approximate quantities, was as follows:

Nature of Work	Quantities cu. yds.	Price	Amount
Earth and loose rock..	28,000	$0.35	$9,800
Solid rock and hard-pan	2,000	1.25	2,500
Total			$12,300
Engineering and contingencies			1,200
Total	30,000		$13,500

Under the specifications, the item of earth and loose rock included anything encountered except ledge or other material that would require blasting for its removal, or boulders of ½-cubic yard or more in volume. The price to be paid for excavation included also the digging and backfilling of necessary trenches for pipes and drains. It was specified that the price bid for excavating should include the placing of all necessary suitable material for embankment and the wasting of the remainder outside of the site which was to be leveled off. Material to be placed in embankments was to be spread in layers not exceeding 6 inches in thickness, the surface to be kept sufficiently level and smooth to permit of sprinkling and rolling. Sprinkling was to be sufficient to keep the earth in the fills damp at all times. Rolling was to be done with a corrugated or spiked road roller weighing at least 12 tons, or with a suitable caterpillar tractor, the rolling to be continuous. Unless the roller wheels were corrugated, the rolling should be followed by harrowing or other means of roughening the surface. The original ground surface was all to be practically parallel with the embankment before placing any fill. The outside slopes and bottom of the reservoir were to be finished to the true line and grade. Inside slopes were not to be closely dressed. Care was to be exercised to avoid wasting excess material down the inside slopes.

At the time of opening bids, twelve contractors made tenders, showing prices for earth and loose rock ranging from 19 cents to 90 cents, and for solid rock and hard-pan from 80 cents to $2.50; and the total bids based on approximate quantities ranged from $7,180 to $30,200. The bid of Pickering Brothers in the amount of $7,180, based on approximate quan-

tities, was accepted after the matter had been discussed with them as to their ability to carry the contract through on the low prices submitted.

Prior to the letting of the contract in December, 1921, the weather had been unusually moderate, but shortly thereafter heavy and frequent storms ensued, accompanied by extremely cold weather. These conditions prevailed practically from the time the contract was let until very late in the spring. The result was, of course, that the contractors were caused much trouble, expense and delay.

Establishing Camp and Wages Paid

The contractors located their camp near Emigration Creek, approximately 1,000 feet distant from the reservoir site, where their bunk and board wagons were placed. Near-by they were able to rent a large barn for their teams and for the storage of hay. Alfalfa hay cost at the time $20 per ton in the city and had to be hauled approximately 4 miles to the site, as also the grain necessary for the feed of their teams. The teams were owned by the contractors.

The average number of men employed was about 25, but varied by 5 or 6 in number. Wages paid were from $3 to $4 per day. About twenty 2-horse teams were used on the average.

Construction Methods Employed

The work was begun with 2- and 4-horse teams and fresno scrapers, and was continued until portions of the reservoir were excavated fairly deep when a steam shovel was placed in the bottom, loading into bottom-dump wagons. This arrangement did not prove satisfactory, however, and fresnos were again resorted to. Later on, these were replaced with wheel scrapers, which gave the most satisfactory results of any of the methods tried. The materials encountered were, about in the order of their occurrence, clay, fine sand, some boulders, and cemented material. Fine sand prevailed mainly throughout the entire excavation.

In addition to the blasting necessary for the removal of hard-pan and of large boulders, the contractors had to do considerable shooting of frozen ground in order to be able to work it, because of the deep frost and the continuous freezing during about three months. The average yardage handled during days that they were able to work was about 250 cubic yards per day. The largest quantity of material taken out in one day was about 400 yards.

Embankments and Slopes

On account of the frequent and heavy precipitation and the wetness of the ground, comparatively little sprinkling was necessary. Also, because of the nature of the method of excavating employed, the contractor was not required to roll the embankment. The constant tramping of the teams over the fills, as well as the scrapers and dump-wagons employed, was very effective in compacting the embankments. The dressing of the slopes was carried out about as required by the specifications. The finishing of the bottom of the reservoir required considerable hand work, the material being removed from the basin by means of a runway with wheel scrapers. Comparatively little ex-

SUNNYSIDE RESERVOIR COMPLETED AS PER CONTRACT, SHOWING WATER BEING TURNED IN AND REGULAR INLET AT RIGHT

cess material was wasted down the inside slopes, through care on the part of the contractors in dumping the dirt in such a way as to maintain the approximate slope without allowing any excess material to roll down. However, it became necessary also to trim the slopes somewhat, partly by hand labor and partly with scrapers, in order to bring the slopes to the grade required.

Difficulties Encountered

The main troubles, as stated, were due to extremely cold, wet weather prevailing from about December 25 until the early part of May, with deep frost, which were very unusual conditions. It would appear that most of the work could have been done more effectually by the use of wheel scrapers than by the other means employed.

The contractors anticipated that they would be through with the work by April 10, whereas it was actually nearly 1½ months later before the work was finished. The cost to the contractors greatly exceeded their bid price, largely because of the weather conditions. The final estimate allowed them was $9,624, which was due to their having encountered more material of the hard-pan classification than had been anticipated. In spite of this extra allowance, the contractors were still the losers.

Concrete Lining

On account of financial conditions, the Board of Commissioners was unable to appropriate sufficient money to lay all of the concrete lining for this basin. Besides, it was considered desirable to allow ample time after the completion of the embankments for the shrinkage of the material. For these reasons the concrete lining undertaken consisted of the laying of the floor and about half the height of the slopes, except at the northeast corner, where the lining was built to the full height at the point of intake from the Parley's High Line.

Specifications, Plans and Quantities

The work to be undertaken under this contract consisted of the preparation of the ground in the basin for concreting, the placing of the concrete lining, gates, etc. The necessary preparation included the dressing of the slopes and bottom to subgrade, excavating trenches 12 inches wide by 6 inches deep for gravel leaders, or lateral drains about 20 feet apart, running down the slopes and across the bottom of the reservoir, and placing crushed gravel in these trenches, excavating for and laying a 6-inch vitrified pipe drain surrounded by gravel around the base of the slope to an outlet in the southwest corner of the basin, and the placing of building paper over the gravel leaders prior to concreting. The floor of the basin was designed with a gentle slope from the north, east and south sides toward the center, and thence toward the northwest corner, where the outlet was placed. The concrete lining specified was 5½ inches of 1:2:4 nominal mixture, based, however, on grading of the aggregate, with ½-inch of 1:2 cement mortar topping to be placed immediately following the placing of the concrete. A minimum of mixing water was specified. Reinforcement consisting of ½-inch square bars of medium steel was required at 24-inch centers both ways on the floor, at 10-inch centers horizontally, and at 24-inch centers up and down the slope on the sides of the reservoir. Reinforcement was to be placed 2 inches from the bottom of the slab. At construction joints, the steel was to project at least 2 feet, and overlaps to equal 30 diameters.

The contract called for the placing of a standard bronze-lined 24 x 44-inch cast iron gate set on the slope for the clean-out pipe, with the necessary gate stem and guides. The contract also included a 3 x 4-foot reinforced concrete flume from Parley's High Line leading to an open concrete basin 10 x 15 feet and 4½ feet in depth, with a Cippoletti weir, situated at the top of the slope at the northeast corner of the reservoir.

The approximate quantities to be undertaken in this work were as follows:

Excavation (dressing of slopes, bottom, etc.) cu. yds.	1,000
Gravel in leaders, cu. yds.	250
Reinforced concrete, cu. yds.	950
Cast iron gate, stem and guides	1
Angle-iron guides for screen, lin. ft.	50
3 x 4-foot conduit at intake, lin. ft.	55
Weir and settling-basin, 10 x 15 feet	1

Bids were received for this work on May 24, 1922. Eleven contractors submitted tenders. The bids were asked for on the basis of a lump sum contract. Our preliminary estimate for this work was $24,000. The bids obtained ranged from $17,427 to $27,613. The low bidders, James & Bell, were awarded the contract and commenced work on June 1. No camp was established at the site, but, on the contrary, the contractors arranged to haul the men back and forth to the street car line—a distance of 1½ miles—on the men's time, for which one truck was used morning and evening. From 17 to 18 men were employed on the average. Wages paid varied from $3.00 to $3.25 for common labor up to $7.20 for cement finishers and steel workers. The sand and gravel for the work were obtained from the north bench, a distance of about 4½ miles. The combined quantity required was about 1,500 cubic yards and cost about $1.95 per cubic yard on the job. Cement cost $3.05 per barrel net, which had to be hauled about 4 miles. The reinforcing steel cost $3,000 in all. This cost included the cutting and bending of the steel. The 6-inch vitrified pipe for the main drain cost $82 in total. The lumber required for chutes, screeds, etc., cost $375. Burlap required for the covering of the concrete on the slopes during the curing period cost $100. The cost of placing the steel was approximately $295.

Excavation

The dressing of the slopes and the finishing of the floor was done by hand labor, all of the material trimmed off the slopes being thrown into the bottom of the basin, whence it was hauled up a runway by means of teams and wheel scrapers onto the embankment. The runway was maintained until a small quantity

of material was left, when the dirt was hauled directly up the slope by means of a scraper.

Installing Drainage

The trenches for the gravel leaders and for the tile drain were dug by hand and the gravel and pipe laid in the same manner, materials being chuted down from the top of the embankment. The laying of the tile was effected by placing a layer of gravel in the bottom of the trench, after which the drain tile was laid on the gravel with open joints, and the remainder of the gravel placed around the pipe. After placing the gravel and before concreting, building paper was laid over the various drains to prevent the concrete from running into the butt joints.

Method Employed in Concreting

The layout for the concreting of the floor and the first 5 feet of the slopes was the placing of the 7½-cubic-foot Wonder mixer in the bottom of the basin and chuting the materials down the slopes. Water was piped into the basin for mixing and for wetting the concrete during curing. The concrete after mixing was wheeled with carts to the portion of the floor where work was in progress. Within half an hour after placing and tamping the concrete, the mortar topping was laid upon it. Practically all of the reinforcement was placed before any concreting began. Construction joints were made, consisting of smooth butt joints against which the new concrete was placed. The grading of the aggregates varied somewhat, but the average mixture was 1:2:4. Six-inch concrete cubes for testing were made and cured under the same conditions as the various portions of the work. Tests of these cubes made at 28 days showed an average strength of 3,300 pounds per square inch. After the concrete had set, the floor was covered with water. The slopes were protected by wet burlap. The concrete was kept wet for 10 days. The maximum quantity of concrete placed in a day was 39 cubic yards. After about the first 5 feet of the slope had been laid with the concrete mixer in the bottom of the basin, the mixer was placed on top of the reservoir and the concrete chuted down the slopes.

Suggested Improvements

The lessons drawn from the contract were that it would have been better to have the reinforcing steel in stock lengths and to bend and cut it on the job. It would also have been better to have the concrete mixer on the top of the slope for all of the work and to have the mixed concrete chuted down and carried thence by carts to any part of the floor. It would also have been advantageous to have an extra mixer for mixing the concrete for the topping.

Results

The concrete was laid during the hot summer, and no contraction joints were provided in it. The construction joints were, as stated, butt joints only. Consequently, when the cold weather occurred later on and the cold water was put in the reservoir, the contraction of the joints was such as to cause considerable leakage of water. This leakage caused a washing out of fine sand back of the concrete lining in places, with consequent cracking of the lining. It became necessary, therefore, to cut out some of the concrete, to refill portions of the slope which had been washed out, and to pour the construction joints with tar, using strips of burlap for a membrane. The provision should be made on all such reservoirs for lapped contraction joints, unless the concrete were laid under such temperature conditions as would tend to cause expansion rather than contraction when the reservoir is filled to capacity.

The reservoir has been in use since the fall of 1922 and has been operating very satisfactorily, with considerable saving of water that formerly ran to waste because of the impracticability of entirely regulating the supply to the pressure main. The embankment is, apparently, thoroughly compacted at present, but for lack of funds the city will not be able to proceed with the remainder of the concrete lining this year.

The outlet pipes and drains were laid by the Water Works Department. The entire design and supervision of this improvement were handled by the Engineering Department of the city of Salt Lake, Utah.

Transportation Service Needed

WITH the advent of good construction weather and a sudden issuance of important permits, increased demand for all materials has seriously depleted the stocks of most dealers and manufacturers. In many cases the manufacturers' stocks are barely enough to balance the excess of demand over production, while in a few cases the stocks are piling up at the plant because of lack of cars for delivery, even though most of that material is already contracted for.

It has been observed by a prominent dealer that most dangers of a shortage could be negated if the railroads could give a service that would enable the manufacturer to keep his plant clean for continuous production. Of course it will be impossible for production alone to take care of a peak load; consequently, the solution would lie more in better transportation and a reservoir of stocks that could be relied on to take care of the overload that occurs at this time of the year.

With the unprecedented condition that now faces the construction industry, with no such reservoir to draw from, and with transportation so woefully inadequate to our needs, it will be practically useless to expect a plentiful supply of any material until building has settled down to a steadier gait.

—*The American Contractor.*

Excavating and Hauling Outfits

A NASH TRUCK EQUIPPED WITH TWO-COMPARTMENT HEIL BODY FOR GENERAL HAULING SERVICE

AN OWEN BUCKET HANDLING EXCAVATION FOR BASEMENT OF NEW BUILDING

The Bates Experimental Road

Summary of Valuable Information Secured by the Division of Highways of the State of Illinois from Its Two-Mile Straightaway Experimental Road

FOR nearly three years articles have appeared in technical magazines and in the newspapers describing the experimental highway of the Division of Highways of Illinois, a project of unprecedented magnitude, conceived and constructed to furnish reliable information to be used in designing the pavements for 5,000 miles of state highway. From its location, the scene of the test became known as the Bates Experimental Road.

The test road consisted of 63 sections of pavement, each 18 feet wide and from 100 to 250 feet in length, laid end to end, so that they made a continuous straight pavement 2 miles long. Twenty-two of these sections were of brick, 17 of asphalt, and 24 of concrete. In each type of pavement, the sections varied from those so thin that they were sure to break under the lighter test loads, to sections which were considered strong enough to successfully support the heaviest load permitted by the state traffic laws. All the material for the pavement conforms to the high standards required by the State Highway Department.

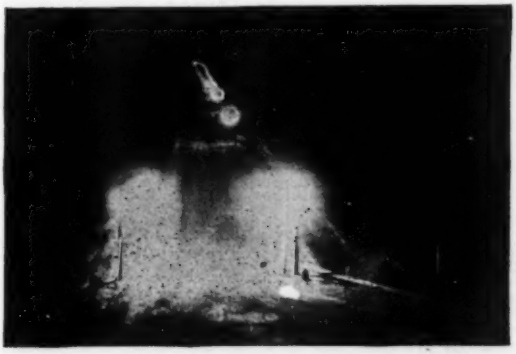
Over this pavement a fleet of army trucks made 23,200 round trips. Beginning with the bare chassis, loads were increased in 2,000-pound increments until a load of 10 tons was reached. The greatest traffic imposed upon any section was 377,460 tons, of which 52.6 per cent was the state legal load limit of 4 tons per rear wheel. A summary of the test traffic is shown in the following table:

GENERAL VIEW OF THE BATES EXPERIMENTAL ROAD

Although a complete study of the results of the traffic run has not yet been made, the following general comparisons are quoted from Clifford Older, Chief Highway Engineer, Illinois State Division of Highways:

SUMMARY OF TRAFFIC

Increment	Load in Pounds on Each Rear Wheel	Load in Pounds on Each Front Wheel	Gross Load	Net Carried or Live Load in Pounds	Number of Round Trips Day	Number of Round Trips Night
First	2,500	2,250	9,500	....	1,000	....
Second	3,500	2,150	11,300	....	2,167	1,033
Third	4,500	2,000	13,000	1,700	2,000	1,000
Fourth	5,500	1,900	14,300	3,500	2,000	1,000
Fifth	6,500	1,800	16,600	5,300	2,000	1,000
Sixth	8,000	1,930	19,860	8,560	5,000	5,000



TO MAKE DAY AND NIGHT OPERATION POSSIBLE, THE ROAD IS ADEQUATELY ILLUMINATED

Bituminous Filled Brick on Macadam Base.—"A difference in the thickness of base, thickness of the brick or type of brick, apparently had no effect upon the load-supporting capacity of these sections. All five sections failed at approximately the same time and to the same extent."

Asphaltic Concrete on Macadam Base.—"No consistent ratio of strength to thickness of base appears. Apparently, traffic-supporting capacity increases with an increase in thickness of asphaltic top. The evidence supporting this point is not conclusive, however."

Asphaltic Concrete on Concrete Base.—"The assumption made at the beginning of construction that an asphaltic concrete wearing sur-

face on a concrete base would have its traffic-supporting capacity equal to that of a concrete pavement having a thickness equal to that of the base, plus one inch, seems to have been a fair guess. It is further evident that increased base thickness is accompanied by increased strength."

Bituminous Filled Brick on Concrete Base.—"The original assumption that a bituminous-filled brick wearing surface on a concrete base has a strength equal to that of a concrete slab having a thickness equivalent to that of the base, plus one-half the thickness of the brick surface, was apparently incorrect. In practically every instance the concrete pavement sections proved of greater strength than their supposed equivalents in bituminous filled brick."

Monolithic Brick.—"The original assumption that the brick surface in this type of pavement acts as a unit with the concrete of the base, thus forming a truly monolithic slab having the same carrying capacity as an equal thickness of concrete, was disproved early in the traffic tests. It was clearly evident that the strength of the so-called monolithic section was less than that of a concrete section of the same thickness.

"In comparing an added inch of brick with an added inch of concrete base, the total thickness remaining the same, it was noticed that the thicker base section has the advantage."

Concrete.—"Soon after starting traffic it developed that the sections containing special cement or other chemicals showed less strength

RESULTS OF TRAFFIC TESTS ON BATES EXPERIMENTAL ROAD, WITH SECTIONS LISTED UNDER INCREMENT DURING WHICH FAILURES OCCURRED

Increment Under Which Failure Occurred	Section No.	Type	Surface	Base	Cushion Inches	Total Thickness Inches
First	10	Asphalt on Gravel	2-in. Topeka	4-in. Nevoculite		6
	33	Monolithic Brick	3-in. Brick	2-in. 1:2:3½ Conc.		5
	39	Concrete, Cemite Cement	4-in. 1:2:3½			4
Second	1-A	Bit. Filled Brick on Macadam	3-in. lug	4-in. Macadam	2	9
	1-B	Bit. Filled Brick on Macadam	3-in. lugless	4-in. Macadam	2	9
	2	Bit. Filled Brick on Macadam	4-in. lug	4-in. Macadam	2	10
	3	Bit. Filled Brick on Macadam	4-in. lugless	4-in. Macadam	2	10
	4	Bit. Filled Brick on Macadam	4-in. lug	8-in. Macadam	1	13
	5	Bit. Filled Brick on Macadam	3-in. lugless	8-in. Macadam	2	13
	7	Asphalt on Macadam	2-in. Topeka	8-in. Macadam		10
	11	Asphalt on Macadam	2-in. Topeka	4-in. Macadam		6
	26-A	Bit. Filled Brick on Conc.	4-in. lug	4-in. 1:2:3½ Conc.	1	9
	27	Bit. Filled Brick on Conc.	3-in. lug	4½-in. 1:2:3½ Conc.	1	8½
	29-A	Bit. Filled Brick on Conc.	3-in. lug	4½-in. 1:3:5 Conc.	1	8½
	30	Bit. Filled Brick on Conc.	3-in. lug	3½-in. 1:2:3½ Conc.	1	7½
	32-A	Bit. Filled Brick on Conc.	3-in. lug	3½-in. 1:3:5 Conc.	1	7½
	56-B	Concrete, 2½% Calc. Chloride	5-in. 1:2:3½			5
	61-A	Concrete, 7½% Hydr. Lime	4-in. 1:2:3½			4
	62	Concrete (see Footnote No. 4)	4-in. 1:2:3½			4
Third	6	Asphalt on Macadam	2-in. Topeka	10-in. Macadam		12
	28	Bit. Filled Brick on Conc.	3-in. lugless	4½-in. 1:2:3½ Conc.	1	8½
	34-A	Semi-monolithic Brick	3-in. Brick	2-in. 1:2:3½ Conc.	3½	5½
	35	Monolithic Brick	4-in. Brick	2-in. 1:2:3½ Conc.		6
	36	Monolithic Brick	3-in. Brick	3-in. 1:3:5 Conc.		6
	37	Monolithic Brick	3-in. Brick	3-in. 1:2:3½ Conc.		6
	38	Monolithic Brick	4-in. Brick	3-in. 1:2:3½ Conc.		7
	55	Concrete	5-in. 1:2:3½			5
	56-A	Concrete, 4% Calc. Chloride	5-in. 1:2:3½			5
	57	Concrete, Cemite Cement	5-in. 1:2:3½			5
	60	Concrete, 2½% Calc. Chloride	4-in. 1:2:3½			4
	61-B	Concrete, Plain	4-in. 1:2:3½			4
Fourth	9	Asphalt on Macadam	2-in. Topeka	6-in. Macadam		8
	12-A	Asphalt on Concrete	2-in. Topeka	4-in. 1:3:5 Conc.		6
	13	Asphalt on Concrete	(1½-in. Topeka, 1½-in. Binder)	4-in. 1:3:5 Conc.		7
	14	Asphalt on Concrete	3-in. Topeka	4-in. 1:2:3½ Conc.		6
	15	Asphalt on Concrete	(1½-in. Topeka, 1½-in. Binder)	4-in. 1:2:3½ Conc.		7
	18	Asphalt on Concrete	(1½-in. Topeka, 1½-in. Binder)	3-in. 1:2:3½ Conc.		8
	39	Monolithic Brick	4-in. Brick	4-in. 1:3:5 Conc.		8
	54	Concrete, Plain	5-in. 1:2:3½			5
	58	Concrete, Plain	4-in. 1:2:3½	4-in. Crushed Stone		8
Fifth	8	Asphalt on Macadam	(1½-in. Topeka, 1½-in. Binder)	5-in. Macadam		8
	16	Asphalt on Concrete	2-in. Topeka	5-in. 1:3:5 Conc.		7
	29-B	Bit. Filled Brick on Conc.	3-in. lugless	4½-in. 1:3:5 Conc.	1	8½
	32-B	Bit. Filled Brick on Conc.	3-in. lugless	3½-in. 1:3:5 Conc.	1	7½
	44	Concrete, Plain	7-in. 1:2:3½			7
	45	Concrete, Circumf. Reinf.	6-in. 1:2:3½			6
	53	Concrete, Wire Mesh Reinf.	5-in. 1:2:3½			5
Sixth	17	Asphalt on Concrete	2-in. Topeka	5-in. 1:2:3½ Conc.		7
	19	Asphalt on Concrete	2-in. Topeka	6-in. 1:3:5 Conc.		8
	20	Asphalt on Concrete	2-in. Topeka	6-in. 1:2:3½ Conc.		8
	23-A	Bit. Filled Brick on Conc.	3-in. lug	6½-in. 1:2:3½ Conc.	1	10½
	23-B	Bit. Filled Brick on Conc.	3-in. lugless	6½-in. 1:2:3½ Conc.	1	10½
	24	Bit. Filled Brick on Conc.	3-in. lug	5½ in. 1:2:3½ Conc.	1	9½
	26-B	Bit. Filled Brick on Conc.	4-in. lugless	4-in. 1:2:3½ Conc.	1	9
	31	Bit. Filled Brick on Conc.	3-in. lugless	3½-in. 1:2:3½ Conc.	1	7½
	51	Concrete, Wire Mesh Reinf.	6-in. 1:2:3½			6
	52	Concrete, Plain	6-in. 1:2:3½			6
No Decisive Failures	21	Asphalt on Concrete	2-in. Topeka	7-in. 1:2:3½ Conc.		9
	22	Asphalt on Concrete	(1½-in. Topeka, 1½-in. Binder)	8-in. 1:2:3½ Conc.		11
	25	Bit. Filled Brick on Conc.	3-in. lugless	5½-in. 1:2:3½ Conc.	1	9½
	40	Concrete, Plain	9-in. 1:2:3½			9
	41	Concrete, 9 by 25-foot slabs	8-in. 1:2:3½			8
	42	Concrete, Plain	8-in. 1:2:3½			8
	43	Concrete, 9 by 25-foot slabs	7-in. 1:2:3½			7
	46	Concrete, Circumf. Reinf.	6-in. 1:2:3½			6
	47	Concrete, Circumf. Reinf.	6-in. 1:2:3½			6
	48	Concrete, Circumf. Reinf.	5-in. 1:2:3½			5
	49	Concrete, Circumf. Reinf.	5-in. 1:2:3½			5
	63-A	Concrete (see Footnote No. 4)	7-in. 1:2:3½			7
	63-B	Concrete (see Footnote No. 4)	7-in. 1:2:3½			7

Sections 41, 43, 45, 46, 48 and 49 have transverse joints every 25 feet and a longitudinal joint the full length of section.

Sections 47 and 50 have transverse joints every 25 feet but no longitudinal joint.

Sections 55 and 63A were made with gravel aggregate. All other concrete sections with crushed stone aggregate.

NOTE 4—Longitudinal joint full length of section; ¾-inch deformed bars 5 feet long and 10 feet centers across longitudinal joint; ¾-inch plain round painted bar 6 inches from each outside edge of slab; continuous through sections 62, 63-A and 63-B.

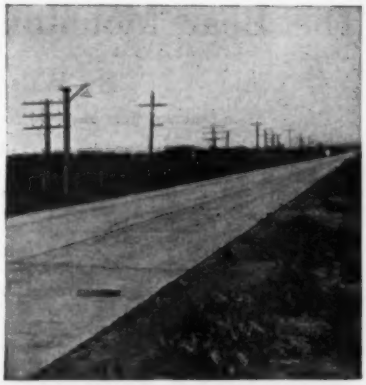
than plain concrete sections of the same thickness.

"Sections containing certain special features of design, consisting of transverse and longitudinal joints with marginal steel, showed greater strength than plain concrete sections of the same thicknesses."

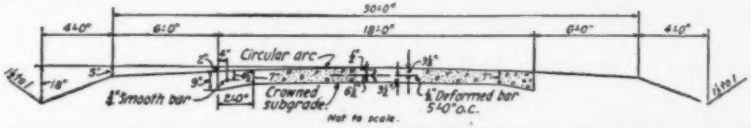
The accompanying table, summarizing the results of the traffic tests, shows that two asphalts, one brick and ten concrete sections carried the entire test traffic without a decisive failure. All the concrete in these thirteen successful sections, whether in a concrete base or a concrete pavement, was proportioned 1:2:3½.

Five new sections, 350 feet long, have been built and will be subjected to traffic this spring. These two sections have thickened edges, similar to those shown in the accompanying cut. Those sections of the original road which did not fail in the first test and sections which could be easily patched will also be subjected to the new traffic.

As a result of the Bates road test, the state has already changed its design for concrete pavement and for concrete bases under block top pavements to a cross-section with thickened edges.



SECTION 40 OF THE BATES ROAD, LOOKING TOWARD SECTIONS 41, 42 AND 43, ALL OF WHICH CARRIED ALL THE TRAFFIC WITHOUT FAILING



CROSS-SECTION FOR CONCRETE ROADS ADOPTED BY THE ILLINOIS DIVISION OF HIGHWAYS AS A RESULT OF THE TRAFFIC TESTS ON THE BATES EXPERIMENTAL ROAD

Thickened edges and the center joint are also specified for concrete bases under asphalt tops. The center joint with uniform base thickness is specified for brick pavement

Savings and Expenditures Doubled

A CONTRACTOR and a banker were talking about building recently, and the more the contractor explained conditions, the more internally heated he became about high wages and material prices.

"I am plumb disgusted," he said. "Wages are going higher and prices just as bad. It is a terrible situation."

The banker leaned forward, "Have you ever stopped to think that your chances for realizing on good business methods have doubled since the good old days you speak about?"

"I do not quite get you on that," answered the contractor with a gleam of interest in his eyes.

"I mean just this. Taking into consideration the fact that labor costs and material prices have doubled, or nearly so, there is the interesting situation for you that whenever by good management you can save a labor hour or a unit of material your profit in the saving is twice as much as in bygone days.

"In other words, your premium on job efficiency and on business efficiency in contracting is doubled. By George, I warm up to the possibilities of the matter as I present them to you.

"The battle is worth the candle. It is not an easy battle but your premium for success is raised one hundred per cent. The one thing for you to do is to look for efficiency."

Certainly there is great incentive in these days of high labor costs and material costs to produce efficiency; but we must not forget that there is still another standpoint to be taken into consideration.

While it is true that through any move for efficiency you can save double the number of dollars now that you could before the war, it is also true, providing we accept as a rough average a 100 per cent higher cost level, that when we go to spend these dollars we have made, we find they will buy only half as much as they did before the war.

This is no reason whatsoever for neglecting the saving through efficiency, but it is not wise to neglect this point that the dollar will not buy so much; else, when the contract is completed, there may be, even with the greatest efficiency, disappointment in the results. Of course there is always the interesting possibility that if we bank our savings we may hold them till a time when the dollar will have greater purchasing power.

—*The American Contractor.*

The Bear Mountain Hudson River Bridge

By Wilson Fitch Smith

Chief Engineer, Bear Mountain Hudson River Bridge Company, New York City

THERE is no highway bridge across the Hudson River south of Albany. For a distance of 144 miles, of which 125 miles is within the boundaries of New York State, the majestic river has always been a natural barrier to east-and-west traffic. Before the advent of the automobile such highway traffic as existed was accommodated by more or less adequate ferry service at various points, but with the recent phenomenally rapid increase in the use of the automobile, both for pleasure and commercial transportation, the ferries have been unable to handle the greatly increased traffic which crowds the highways during the summer months, especially on holidays, and a bridge across the Hudson River has become an imperative public need.

To anyone who is not familiar with the crowded conditions of the highways in the Hudson River Valley, the following figures will be of interest:

Traffic counts of automobiles made in the summer of 1922 on the Albany Post Road north of Peekskill showed as follows:

Sunday	5,557
Saturday	3,881
Average of 5 week days	2,193

and on the main road north from Tuxedo:

Sunday	10,821
Saturday	6,314
Average of 5 week days	2,745

These figures show the present amount of traffic. The rapid development in the use of the automobile as obtained from the state registration figures shows the average increase from year to year for the past seven years as follows:

	Per Cent
New York State	26.8
New Jersey	25.4
Pennsylvania	26.4
Connecticut	27.1
The entire United States	29.4

These figures include the years of depression following the war.

Naturally, one thinks of the vicinity of New York City as the logical location at which to bridge the Hudson River. Unfortunately, the width of the river at New York and the restrictions imposed in favor of navigation make a bridge at this point a gigantic project, which, although it has been studied seriously for thirty years or more, has not, up to the present time, developed beyond the project stage. The prohibitive width of the river continues until the Highlands are reached, where there are several practical locations, both below and above West Point. Above the Highlands, the river again widens, so that the only possible location for a single-span bridge of practical length in the vicinity of New York City is found in the Highlands.

The site chosen for the Bear Mountain Hudson River bridge is the nearest practical location to New York City. It is about 3 miles north of Peekskill and 45 miles from 42nd Street. It is on a fairly direct east-and-west route from Danbury to Port Jervis. It can be reached by several routes from southern New England without entering New York City. It will tie together the north-and-south routes on both sides of the river at a strategic point and will give direct access from New York City to Bear Mountain Park, West Point, the spectacular Storm King Road, the Shawangunk and Catskill Mountains, and will afford a direct route from the farming districts of Orange and Ulster Counties to the metropolitan district of New York.

The site chosen is an ideal one for a suspension bridge. The towers are located close to the river banks on the rocky shores, so that suitable foundations will be had with a minimum of excavation. On the east side, Anthony's Nose rises abruptly from the river, a solid mass of granitic gneiss. The New York Central Railroad tracks are in a tunnel at this point. On the west side, the base of Bear Mountain is at the elevation of the approach road. The tower foundations will be between the West Shore Railroad tracks and the river, and the latter will be crossed by the approach span. On both sides, the anchorages will be had by tunneling directly into the solid rock on the axis of the cable backstays.

The east end of the bridge will be reached by an approach highway to be constructed from Roa Hook on the southerly slope of Anthony's Nose, a distance of about three miles, and will connect with the Albany Post Road at Annsville, by way of the state road leading to the State Camp. This approach highway will be of standard state highway construction with concrete pavement and over much of its distance will involve steep side-hill construction, in some places approaching the boldness of the Storm King Road. Generally, the road will be at an elevation of 200 feet above the river, but at one point it rises to 400 feet and it will afford many picturesque and spectacular views of the river and the Highlands.

The approach highway to the west end of the bridge will be about 1,000 feet long and will connect with State Route No. 3 just above Bear Mountain Park Inn.

The bridge itself will be a suspension bridge of 1,632 feet span between the towers, 32 feet longer than the Williamsburg Bridge over the East River at New York, which at the present time, is the longest suspension span in the world.

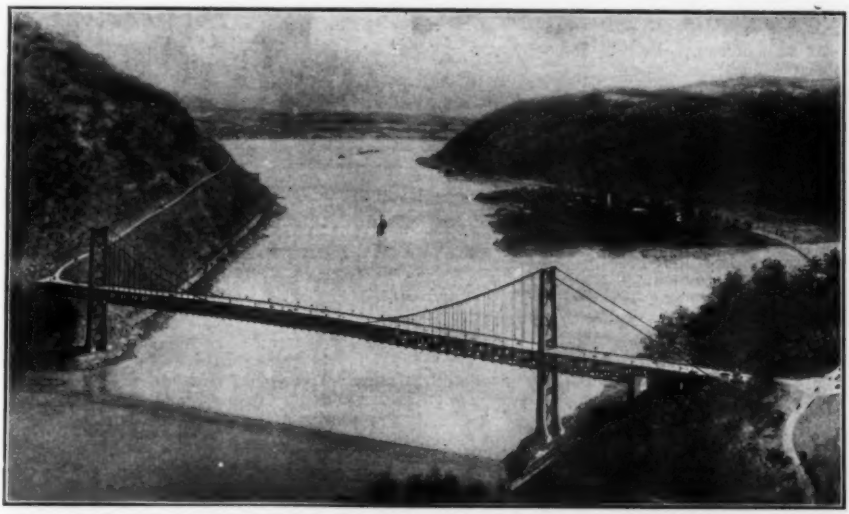
The towers will be of steel, 355 feet high above the foundations. Each tower will con-

sist of two legs made up of multiple-plate and angle-box construction, 6½ feet by 30 feet in section at the base, tapering to 6½ feet by 10 feet at the top. Each tower leg will rest on a cast steel base 10 feet by 35 feet and 4 feet 9 inches high, weighing 114 tons. The legs will be tied together by heavy struts and diagonal bracing. The weight of each tower will be 2,315 tons. The saddle castings which carry the cables at the tops of the tower legs will be of cast steel and each will weigh 16 tons.

The river span will be suspended from two steel wire cables, each 17 inches in diameter and containing 7,252 galvanized steel wires, 0.192-inch diameter of 215,000 pounds per tower. The total amount of steel in the structure will be about 12,500 tons including trusses and towers.

In the illustration shown the artist has chosen a viewpoint about 600 feet in the air above Fort Montgomery and is looking southeast towards Peekskill in the distance. The mountain on the left bank is Anthony's Nose, and the one on the right bank in the middle distance is Dunderberg.

The bridge is being built with private capital by the Bear Mountain Hudson River Bridge Company, of New York City, under a charter granted by the New York Legislature. Construction is already under way, and it is expected that the bridge will be completed ready for traffic before the end of 1924. The estimated traffic for the first year of operation is over 600,000 vehicles a year.



ARTIST'S SKETCH OF BEAR MOUNTAIN HUDSON RIVER BRIDGE, LOOKING SOUTH TOWARD PEEKSKILL, N. Y.

A portion of Bear Mountain Park is seen in the right foreground

square inch ultimate strength. The cables will be 60 feet apart. The stiffening trusses of the suspended span will be of the single diagonal and post riveted type, of silicon steel, 30 feet deep and 55 feet center to center. At the east end the approach will be a truss span 210 feet long. At the west end the approach will consist of a truss span 210 feet long, one 100-foot truss span and two 50-foot plate girder spans. The total length of the bridge between abutments will be 2,258 feet.

The floor, at the level of the upper chords of the stiffening trusses, will be 48 feet wide between railings and will carry a 38-foot roadway and two 5-foot sidewalks, one on each side of the roadway. The clear height of the bridge above the river surface will be 155 feet at the center of the span and 139 feet at each

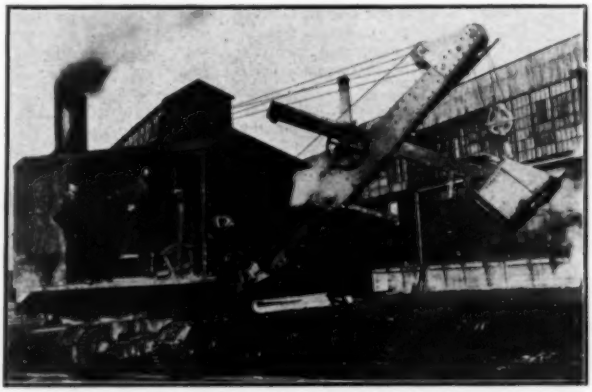
The bridge was designed by Howard C. Baird, of Hodge & Baird, who will act as consulting engineer on the bridge for the Bridge Company. Professor William H. Burr and Major William A. Welch are also on the company's consulting staff, and the author is Chief Engineer for the Bridge Company. The general contractors are The Terry & Tench Company, Inc., well-known structural erectors and bridge builders. McClintic-Marshall Company of Pittsburgh, Pa., is fabricating the steel, and the John A. Roebling's Sons Company, of New York, is manufacturing the cable wire and suspender ropes.

Certainly, it cannot be claimed as altogether inconsistent for a person possessing a dogged determination to occasionally be regarded as a howling success.—*Steam Shovel and Dredge Magazine.*

A 10-Ton Steam-operated Crawler Crane

A Description of a Machine That Is Ready to Take Care of Widely Varying Work on Different Jobs

A 10-TON steam-operated crane which can be used to operate a clam-shell or orange-peel bucket, or a dragline bucket, handle a lifting magnet, or operate a steam shovel attachment, which develops a single-line pull of 10,000 pounds, can operate a pile-driving attachment or back-filling attachment or a skimmer scoop, and gives a single line hoisting speed of 200 feet per minute, has recently been placed on the market by the McMyler-Interstate Company, Cleveland, Ohio. This machine handles a 30,-35- or 40-foot boom, can swing five complete revolutions per minute, can climb a 30-per cent grade without load, will travel under its own power on its crawler traction at the rate of 100 feet per minute in any direction regardless of the direction in which the boom is pointed, and steers without any assistance of the ground man. It is also claimed to give full power to the crawlers while steering.



A STEAM CRAWLER CRANE CONVERTED INTO A STEAM SHOVEL WITH ¾-YARD BUCKET

The crane has many features which will interest contractors on all kinds of work. This No. 2 McMyler-Interstate steam crawler will climb easily over railroad tracks, will crawl without hesitating through sand and mud up grade and down, and will turn around almost within its own length.

For highway construction, road building, excavating, backfilling, building and construction work, the crane is available for each new job as rapidly as the buckets can be changed. It is built like a locomotive crane, sturdy and generous throughout, so that it will stand up under hard work day in and day out, allowing the operator full time to devote to production.

In designing the crane, full appreciation was given to the desirability of having all parts of the mechanism readily accessible for adjustments and repairs. Practically every part of the crane subject to wear may be taken down by the moving of center bearing caps. The frictions may be relined without disturbing any of the mechanism. The few adjustments on the crane are within easy reach of the operator.

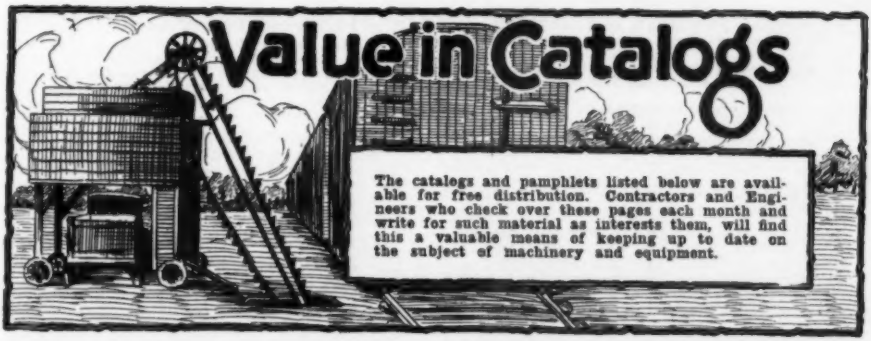
The crawlers are of patented design and embody features which are claimed to give a uniform drive over the entire face of the crawler tread, insuring stability while traveling and eliminating the possibility of tooth breakage or of the treads jumping the sprocket wheels. The crawler treads form a continuous steel track for eight hardened steel rollers. An adjustment screw is provided to take up any slack which may develop in the treads.

The steering is accomplished under any conditions by the crane operator from his platform in the cab, without the assistance of a ground man to throw clutches or to hook up steering rods. By throwing a hand lever and swinging the crane in the desired direction of travel, the machine is easily steered about curves and sharp corners. If desired, the crane may be pivoted on one crawler. Of especial importance is the fact that the crane may be steered in any direction irrespective of the relative position of the cab and the running gear. This feature is essential when traveling over roads.

In addition to handling various bucket and line work, this crane may be readily converted in the field to a ¾-yard steam shovel. An attachment is provided for driving piles, if desired.

Increase in Tractor Prices

MONARCH Tractors, Inc., Watertown, Wis., has announced that on July 1, 1923, there will an increase in the prices of the three types of Monarch tractors, made necessary by the increases in prices of all materials going into the construction. The Model C 20-30 tractor will be priced $3,800; Model 4-40, $4,350, and Model 6-60, $5,750.


Value in Catalogs
The catalogs and pamphlets listed below are available for free distribution. Contractors and Engineers who check over these pages each month and write for such material as interests them, will find this a valuable means of keeping up to date on the subject of machinery and equipment.

THE SOLUTION OF ROAD OIL PROBLEMS

A booklet, "Standard Road Oil," issued by the Standard Oil Co. of Indiana, 904 S. Michigan Ave., Chicago, Ill., describes the several uses recommended for the various grades of Stanolind road oil.

STEEL JOIST BRIDGES SAVE MONEY

The Steel Joist Bridge Co., Kankakee, Ill., has recently placed on the market a steel joist bridge which comes packed flat and is easily installed at less cost than wood bridges. The literature of this company is free on request.

MOVING MORE EARTH WITH LESS POWER

The advantages of Stockland quick-lift graders in road work are described in literature issued by the Stockland Road Machinery Co., 3326 27th St., E., Minneapolis, Minn.

SPEEDING UP THE CURING OF CONCRETE

Solvay calcium chloride, used on the "Ideal Section" of the Lincoln Highway for speeding up the curing of the concrete, is described with its various uses, in the literature of the Solvay Process Co., Syracuse, N. Y.

PAVING TOOLS AND POURING POTS

Littleford Bros., 500 E. Pearl St., Cincinnati, Ohio, tells all about Littleford tar and asphalt heaters, paving tools and pouring pots in their complete catalog, which may be secured gratis by readers of **Contractors' & Engineers' Monthly.**

FREE BULLETIN ON DRAGLINE CABLEWAYS

Sauerman Bros., 461 S. Clinton St., Chicago, Ill., issue a free monthly publication devoted to information on dragline cableways and power scrapers, which may be secured by any contractor sending in this item.

DUMP-WAGONS AND CARTS

In its new catalog No. 53, the Columbia Wagon & Body Co., Columbia, Pa., describes in detail its complete line of road wagons, loggers and handy wagons, new model patent dumping wagons, four-wheel dump-carts and other types of value for contractors.

CASTINGS FOR STREET DRAINS

All types of street drainage castings, including catch-basins, basin inlets, manhole covers, coal-hole covers and drains, are described in a loose-leaf booklet, recently issued by E. G. Munson, Utica, N. Y.

DIGGING DITCHES AT LESS COST

J. D. Adams & Co., Indianapolis, Ind., manufacturers of adjustable leaning wheel graders, will be pleased to send information on the use of these graders with back sloper attachment, which makes is possible for contractors to make roadside ditches at less cost.

INSIDE WORKINGS OF MIXER COMPANY

The Koehring Co. has begun the publication of a magazine devoted to the interests of members of the Koehring organization. Contractors and others interested in the inside workings of the organization may be put on the list to receive this magazine by writing to O. C. Dahlman, Editor, Koehring Co., Milwaukee, Wis.

CONTRACTORS' LANTERNS

Catalog No. 50, issued by the R. E. Dietz Co., 60 Laight St., New York City, contains complete listings of its lanterns of all types for contractors' service.

TRUTH OF MOTOR TRUCK VALUE

Booklet S-23, "Making One Thing Better," issued by the Federal Motor Truck Co., Detroit, Mich., contains information that a contractor wants when he is considering the purchase of a modern motor trucks for general contracting work.

BUILDING CHEAPER PAVEMENTS

Contractors will be interested in the latest booklet of the National Pavements Corp., 60 Broadway, New York City, entitled "The Most Profitable Road in the World," and describing all features of laying this pavement, made out of fine dust and bituminous material.

A TONGUE-AND-GROOVE EXPANSION JOINT

The latest literature of the Philip Carey Co., 8 Wayne Ave., Lockland, Cincinnati, Ohio, describes in detail the new Elastite tongue-and-groove expansion joint, which has many advantageous features in concrete road construction.

A TRACTOR WITH RESERVE POWER

Advance-Rumely Oil-Pull road-building tractors, which are claimed to have 25 per cent reserve power in the motors, are described in detail in a new 20-page catalog, filled with illustrations and data, which may be secured from the Advance-Rumely Thresher Co., Inc., LaPorte, Ind.

BAR BENDERS AND CUTTERS

The Electric Welding Co., Dept. A, 311 Ross St., Pittsburgh, Pa., will be pleased to furnish contractors with its complete list of steel for reinforced concrete and its accessories, steel spirals for columns, pipe and tile bar benders and cutters.

CLAM-SHELL AND ORANGE-PEEL BUCKETS

In a 24-page illustrated catalog, the Vulcan Iron Works, Inc., Jersey City, N. J., describes in detail the main features of Vulcan clam-shell and orange-peel buckets, dredging buckets, dipper or scoop buckets and hydraulic dredge equipment.

FIGURING ASPHALT ROAD JOBS

The Asphalt Sales Dept., the Texas Co., 17 Battery Pl., New York City, will be pleased to place in the hands of every contractor complete information as to why it is helpful to mention that Texaco asphalt is to be figured on when making up estimates for road jobs. This company also issues a complete set of booklets giving specifications and construction methods for all types of asphalt roads.

ONE-MAN EXCAVATORS

Catalog E, recently issued by the Bay City Dredge Works, Bay City, Mich., describes its one-man excavators for clay, sand and gravel pits, as well as its Model 16 convertible crane excavator and land dredges.

LOCATE METERS AT THE CURB

The many advantages of locating water-meters at the curb line are told in the literature of the Ford Meter Box Co., Wabash, Ind., manufacturers of meter boxes for northern and southern service.

A SPEEDY EXCAVATOR AND LOADER

In its new 20-page catalog No. 408-A, the T. L. Smith Co., Milwaukee, Wis., describes in detail, and illustrates the uses of, the Smith excavator and loader for speedy work in basement excavating, gravel excavating and loading, stripping, grading and other contracting operations.

EXPANSION JOINTS THAT LAST

The advantages of Servicised expansion joints, which do not ooze and which expand when the concrete slabs contract, and contract when the slabs expand, are described in detail in the literature of the Servicised Products Co., First National Bank Bldg., Chicago, Ill.

MACHINERY FOR ROAD CONTRACTORS

Catalog No. 24, just issued by the Galion Iron Works & Mfg. Co., Galion, Ohio, describes the complete line of special road-building equipment designed for the use of road-building contractors.

PORTABLE AIR COMPRESSOR UNITS

Bulletin 22-AC, issued by the Domestic Engine & Pump Co., Shippensburg, Pa., describes in detail its standard sizes of 50- and 100-cubic-foot per minute air compressors operated by 13 and 26 horsepower engines for operating pneumatic spades, bush-hammer finishers for concrete work and other contracting jobs.

ASPHALT STREET REPAIRING MADE EASY

The proper bonding of old and new asphalt in sheet asphalt road repairing is made possible by the improved surface heater described in the literature of the Equitable Asphalt Maintenance Co., 1901 Campbell St., Kansas City, Mo.

ECONOMICAL GAS ENGINES

No matter what your gasoline problem may be there is a machine described in the literature of Engine Div., Dept. B, Hercules Corp., Evansville, Ind., which will solve it, whether it be for a concrete mixer, a gasoline crane, or other contracting machinery.

BLAST-HOLE DRILLS

Clipper drills operated by steam, gasoline or electric power which are used by contractors throughout the country for drilling blast holes, test holes, air-holes and water wells, are described in detail in the literature of the Loomis Machine Co., Tiffin, Ohio.

DUMPING MECHANISMS FOR MOTOR TRUCKS

The Heil Co., 1243 26th Ave., Milwaukee, Wis., manufactures Hydro dump body units for all makes of trucks and to handle all kinds of dumping problems encountered in the contracting field. These dumping units are described in detail in literature which may be secured free on request.

WAGON LOADERS

The George Haiss Mfg. Co., 142nd St. and Park Ave., New York City, manufactures a line of wagon loaders which is described in detail in the Company's series of bulletins prepared especially for contractors having material-handling problems.

TANDEM PAVING ROLLERS

The illustrated catalog of the Erie Machine Shops, Erie, Pa., describes in detail Erie tandem paving rollers, which stand up under hard usage and are guaranteed against breakage or wear for five years.

ROAD REINFORCEMENT FOR QUICK SHIPMENT

Contractors building concrete roads should take note of the fact that the National Steel Fabric Co., 709 Union Arcade, Pittsburgh, Pa., has large stocks of National Steel Fabric ready for immediate shipment. This standard road reinforcement, furnished in rolls or sheets, is described in detail in literature which may be secured free on request.

A CATALOG OF ROAD ROLLERS

Catalog A, issued by the Buffalo Springfield Roller Co., Springfield, Ohio, is replete with information regarding the value and uses of steam and motor road rollers with and without scarifier attachments. As this company manufactures both types, it is able to recommend a particular machine best adapted to the work you have under way.

PROTECTING PAVEMENTS FROM EXPANSION

The protection of concrete and block type pavements with Ideal expansion joints, which come shipped in crates or boxes weighing about 325 pounds, is described in detail in literature and price lists of the Waring-Underwood Co., Philadelphia, Pa.

QUICK-DUMPING MOTOR-TRUCK BODIES

The value of Wood-Detroit hydraulic hoists and steel bodies, which are playing a big part in building thousands of miles of better roads, is told in the literature of the Wood Hydraulic Hoist & Body Co., 7942 Riopelle St., Detroit, Mich.

MAKING TRENCH EXCAVATION CHEAPER

If you are figuring on trench work which runs close to trees or poles, and want a machine which can keep going in crowded quarters, producing a trench of almost any width desired, send for the literature of the Buckeye Traction Ditcher Co., Findlay, Ohio, describing its Buckeye excavator with new rotary auxiliary cutter.

CONCRETE ROAD FINISHERS

The full details of the Dunn road finisher, which runs on the road forms and which produces a well-compacted base course or surface course on concrete roads, is described in detail in Bulletin F-1, which may be secured from the Dunn Road Machinery Co., Conneaut, Ohio.

DRIVING CONCRETE PILES

The throttle control of McKiernan-Terry 9-B and 7-B double-acting pile-hammers, is described in detail in Bulletin 31, which contractors should look over before they take on any pile-driving work.

MACHINERY FOR ROAD CONTRACTORS

"Everything for the Road Maker," a complete catalog and text-book on road-building machinery, may be secured by any contractors interested in road work by writing to the Good Roads Machinery Co., Kennett Sq., Pa. It lists and describes road graders, portable and stationary rock crushers, elevators, screens, conveyors, bins, oiling machinery, etc.

STEEL CURB AND GUTTER FORMS

A well-illustrated folder, just issued by the Heltzel Steel Form & Iron Co., Warren, Ohio, illustrates the use of its forms and shows how they have banished wood forms to the scrap pile.

QUICK CURING OF NEW CONCRETE

A well-illustrated practical booklet, "How to Maintain Roads," has been issued by the Dow Chemical Co., Midland, Mich., telling how contractors can open concrete roads weeks sooner than usual and do concreting work later in the winter and eliminate ponding.

A MONORAIL SYSTEM FOR LAYING PIPE

In the latest literature of the Link-Belt Co., Philadelphia, Pa., contractors will find interesting information regarding its electrically operated monorail systems for handling the excavation and backfill of sewer pipe trenches and for laying the pipe itself.

PROTECTIVE BARS FOR CONCRETE CURBS

Curb bars that protect and reinforce curbs and which have positive anchorage, and are rigid and easy to install, are described in literature which may be secured by any contractor desiring it, from the Truscon Steel Co., Youngstown, Ohio.

TRUCKS FOR HEAVY HAULING

Contractors interested in 4-ton heavy-duty trucks for general hauling in contracting fields should secure the latest literature of the Garford Motor Truck Co., Lima, Ohio, describing its trucks from 1- to 7½-ton capacity.

SOLVING DRAINAGE PROBLEMS

The literature of the Newport Culvert Co., 542 W. 10th St., Newport, Ky., describes the uses of Newport corrugated culverts in solving culvert and drainage problems.

A COMPLETE LINE OF CONCRETE MIXERS

The complete catalog issued by the Jaeger Machine Co., 701 Dublin Ave., Columbus, Ohio, describes the full line of Jaeger tilting-drum type mixers in all sizes for all types of concrete work.

TRACTORS THAT WORK LONG HOURS

The C. L. Best Tractor Co., San Leandro, Calif., will be pleased to furnish literature telling of the work of Best Contractors and showing why they work more efficiently for a longer time than horses and mules.

PORTABLE SAW-RIGS

The Oshkosh Mfg. Co., Oshkosh, Wis., has issued a 24-page catalog describing in detail Oshkosh portable saw-rigs and illustrating the details of construction and showing their many uses in the contracting field.

HEAVY-DUTY CORD TIRES

A new type of heavy-duty cord tire for the commercial car is described in detail in the literature which any contractor may secure from the B. F. Goodrich Rubber Co., Akron, Ohio.

CONQUERING HAULING TROUBLES

The Holt Mfg. Co., Peoria, Ill., will be pleased to furnish information to any contractor or engineer interested in the many instances in which Holt Caterpillar tractors have overcome hauling troubles.

A New Gasoline Hammer Drill

Self-Contained Power Unit Makes This Tool Readily Portable and Suitable for Many Types of Work

A NEW gasoline impact drill of the air-hammer type is now being manufactured and placed on the market by the Pennsylvania Gasoline Drill Company, Land Title Building, Philadelphia, Pa. This drilling unit is self-contained and portable and yet is compact enough so that one man can operate it and transport it from place to place. The unit was first developed for drilling rock, but because of its simplicity, the advantages of its application to other work have been recognized and tools provided for cutting asphalt streets, breaking concrete, picking hard earth, ramming backfill in trenches, removing granite block and wood block, drilling foundations, and drilling through walls.

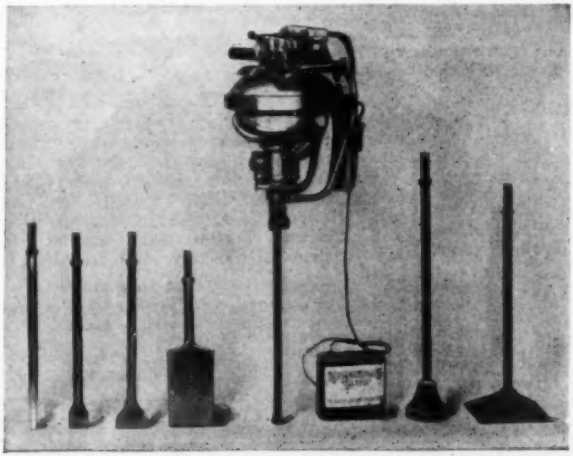
Prior to the introduction of this self-contained machine, all types of power drills were limited in their application by the length of an air hose or by electric wires. Power for either of these methods must be supplied to them by an auxiliary power equipment which, on account of the size and weight cannot be as cheaply transported as a single tool.

The Philadelphia Electric Company has made tests of the gasoline hammer under the direction of J. Wilson Sylvester. The work included the operations required for the opening of city streets. Particular attention was paid to the performance of the gasoline hammer in such work as cutting asphalt, breaking concrete bases, picking frozen earth and tamping backfill. Records in the saving in labor cost of the various operations were carefully kept.

The following are the average time and costs for the gasoline hammer for work compared with hand labor, paid $4.50 a day:

RAMMING BACK-FILL

	Hand Labor	Gasoline Hammer	Daily Saving in Labor
Cutting asphalt surface.	2½ men	1 man	$6.75
Breaking concrete base.	5 "	1 "	18.00
Picking frozen earth...	2½ "	1 "	6.75
Ramming backfill.....	8 "	3 men	22.50



COMPLETE DRILL WITH STREET OPENING TOOLS

For ramming backfill, a cast steel tamper, 8½ x 8½ inches, is used. The backfill is claimed to be so solidly compacted by the gasoline hammer that after the installation of a service conduit, 4½ inches square for the length of the ditch, it was found possible to replace all of the earth removed, thus insuring a more substantial foundation than existed before disturbing. This precludes the possibility of future settlement and also eliminates the cost of disposal of surplus dirt. It appears to be practically impossible to recompact earth by hand labor to prevent it from later settling and causing a depression.

The mechanical principle of this new gasoline hammer

drill combines the action of an air hammer and a gasoline engine in such manner that the drilling unit has but two moving parts, the hammer piston and the fly-wheel assembly. No crank-shaft or connecting rod is employed, and there is no spring or other yielding member used in the internal construction. No outlet or exhaust valves or cam-shafts are used, as the air and gas passages are fixed ports cut through the solid steel of the cylinder.

The down or power strokes of the piston hammer are made with approximately 900 pounds of gasoline explosive force thrusting it forward to hit the drill bit with terrific power. The fly-wheel is employed only to return the hammer piston on the upward or compression strokes. Approximately 1,800 impacts are made each minute. For carburation, a gasoline mixing valve is used which permits the drill to be operated at any angle. While the drill continues to run at full speed, the operator shifts it from one position to another and to any desired angle without affecting its operation. To start the drill, the operator has but to give the rim of the fly-wheel a pull by hand, and even in the coldest weather it is claimed to start with consistent regularity.

Road-Building Costs from Massachusetts and New Hampshire

RECENT bids submitted for 3.761 miles of 18-foot bituminous macadam pavement for construction in Burlington, Mass., are given below. This contract was awarded to Luigi C. Carchia, West Roxbury, Mass.:

1. Earth excavation, 15,490 cu. yds.	1.72
3. Ledge excavation, 4,690 cu. yds.	1.72
5. Plain concrete masonry, 40 cu. yds.	20.00
6. Rein. concrete masonry, 10 cu. yds.	25.00
8. Broken stone, 9,875 tons	2.90
9. Bitum. material, 95,670 gals.	.14
10. 12" c. i. pipe, 70 ft.	4.75
11. 16" c. i. pipe, 30 ft.	5.00
12. 12" r. c. pipe, 315 ft.	3.00
13. 16" r. c. pipe, 35 ft.	3.50
14. 18" r. c. pipe, 390 ft.	3.50
16. Guard-rail, 4,215 ft.	.75
18. Removing and resetting bounds, 106 each	6.00
19. Catch-basins, 4 each	90.00
21. Gravel borrow, 12,040 cu. yds.	1.72
22. Side drains, 710 ft.	2.00
23. Side drains, 520 ft.	2.50
25. Removing and rebuilding stone walls, 5,255 ft.	.90
26. Scarifying, 6,800 sq. yds.	.20
27. Broken stone for surface, 6,165 tons	2.90
28. Stripping of gravel pits, 1,200 cu. yds.	.20
	$131,919.95

The New Hampshire Cement Construction Company, Manchester, N. H., was the successful bidder on a bituminous macadam road for Lebanon, N. H. The low bid is:

1. Earth excavation, 229 cu. yds.	$1.15
2. Borrow, 435 cu. yds.	2.00
3. Rein. conc. surface course, 4,300 sq. yds.	2.96
	$13,861.35

The low bidder, Luigi C. Carchia, of West Roxbury, Mass., on 1,195 feet of 18-foot bituminous macadam made the following bid for construction in Mendon, Mass.:

1. Earth excavation, 590 cu. yds.	$2.00
3. Ledge excavation, 590 cu. yds.	2.00
4. Borrow (exc. gravel), 1,520 cu. yds.	2.00
5. Plain concrete for masonry, 9 cu. yds.	20.00
8. Broken stone, 695 tons	3.53
9. Bituminous material, 6,135 gals.	.16
10. 24" r. c. pipe, 124 feet	5.00
17. Stone fill, 605 cu. yds.	2.00
18. Delivering and setting bounds, 2 each.	5.00
30. Gravel borrow, 1,250 cu. yds.	2.00
31. Sand borrow, 40 cu. yds.	2.00
32. Strip. of gravel borrow pits, 125 cu. yds.	.20
Totals	$13,473.85

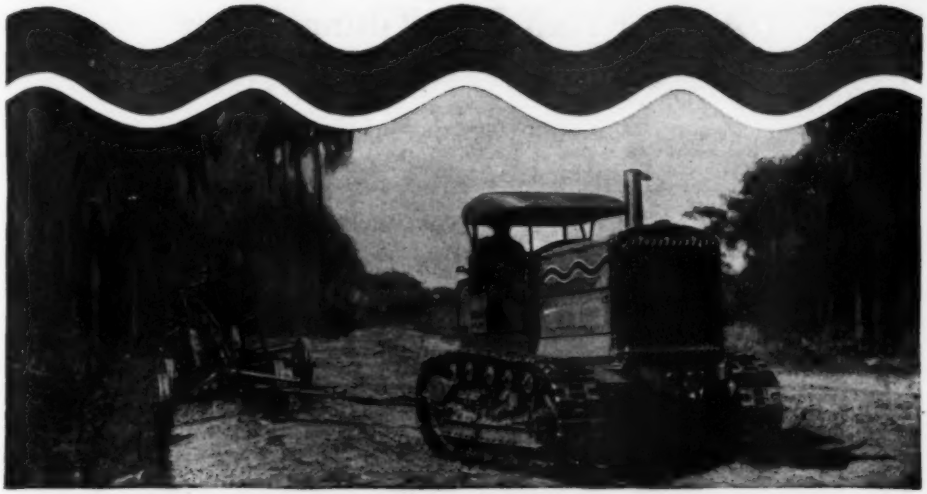
D. O'Connell & Sons, Holyoke, Mass., were the low bidders on a 781-foot bridge with a span of 45 feet for construction in Westfield, Mass. The work of the reinforced concrete beam bridge was 30 feet, and the bituminous macadam approaches varied from 20 to 30 feet. The bids by items are as follows:

1. Earth excavation, 860 cu. yds.	$1.10
2. Bridge excavation, 440 cu. yds.	1.60
3. Ledge excavation, 10 cu. yds.	5.00
4. Borrow, 3,525 cu. yds.	1.35
5. Plain concrete masonry, 2 cu. yds.	26.00
6. Reinforced conc. masonry, 360 cu. yds.	35.00
8. Broken stone, 600 tons	2.75
9. Bituminous material, 5,300 gals.	.15
10. 12" cast iron pipe, 50 feet	4.00
16. Guard-rail, 410 feet	.70
17. Stone fill, 495 cu. yds.	3.50
18. Delivering and setting bounds, 3 each	25.00
21. Gravel borrow, 1,185 cu. yds.	1.50
22. Sand borrow, 35 cu. yds.	1.50
23. Removal of trees, 9 each	10.00
24. Rip-rap, 40 cu. yds.	3.50
25. Reinforced cement masonry, 15 cu. yds.	82.00
26. Rubble concrete masonry, 2 cu. yds.	19.00
27. Stock fence, 500 feet	.50
28. Steel I-beams, 16,170 lbs.	.06½
29. Cement rubble masonry, 5 cu. yds.	10.00
30. Removal of superstructure, lump sum	200.00
31. Strip. of gravel borrow pits, 150 cu. yds.	.20
Totals	$29,123.88

For the construction of a cement concrete pavement for Commonwealth Avenue, Boston, Mass., the bids ran very close, the low bidder, A. G. Tomasello & Sons, Boston, Mass., bidding $58,725, the second, the Rowe Contracting Company, Boston, Mass., $58,740, and the third, J. C. Coleman, Boston, Mass., $62,120. The bids by items of the low bidder are given below:

1. Roadway excavation, 1,800 cu. yds.	$1.90
2. Reshaping foundation, 15,400 cu. yds.	.20
3. Gutters repaved, 2,900 cu. yds.	1.25
4. Concrete surface, 3,000 cu. yds.	12.90
5. Steel, 120,000 lbs.	.05½
6. M. S. & C. B. 30	10.00
7. Rate wages	Prevail
Totals	$58,725.00

ACKNOWLEDGMENT.—Cost figures tabulated from *The Nerba*.



Conquering the Everglades

Through the very heart of the Florida Everglades, world-famed as an impenetrable swamp, indomitable road-makers are now pushing the 250-mile Tamiami Trail. Cities and officials all along the route are keenly interested in the early completion of this trail at lowest possible cost. That's why "Caterpillars"* are so prominent on the job.

C. T. Friend, chairman of the county commissioners at Tampa, says: "Our third "Caterpillar" is now at work, grading the Hillsborough County end of the Tamiami Trail. From the standpoint of upkeep, service and general satisfaction, we feel our investment in these machines has been a mighty good one."

"Caterpillars" have the traction needed for uninterrupted operation over the sandy, boggy places. Their superior speed and endurance means too, that this highway *is* being completed in the shortest time and at the lowest possible cost. Let us show you how the "Caterpillar" can build and maintain *your* roads with important savings of tax funds.

**There is but one "Caterpillar"—Holt builds it*

THE HOLT MANUFACTURING COMPANY, *Inc.*
PEORIA, ILL.

Branches and service stations all over the world

New York, N. Y.
Omaha, Neb.
Kansas City, Mo.
St. Louis, Mo.
Holt Company of Texas, Dallas, Texas

CATERPILLAR
HOLT
PEORIA, ILL.
STOCKTON, CALIF.

Chicago, Ill.
Minneapolis, Minn.
Indianapolis, Ind.
Canadian Holt Company, Ltd., Montreal

A New Half-Bag Tilting Mixer

New Mixer Built in Two Models Will Prove Serviceable in Contracting Field

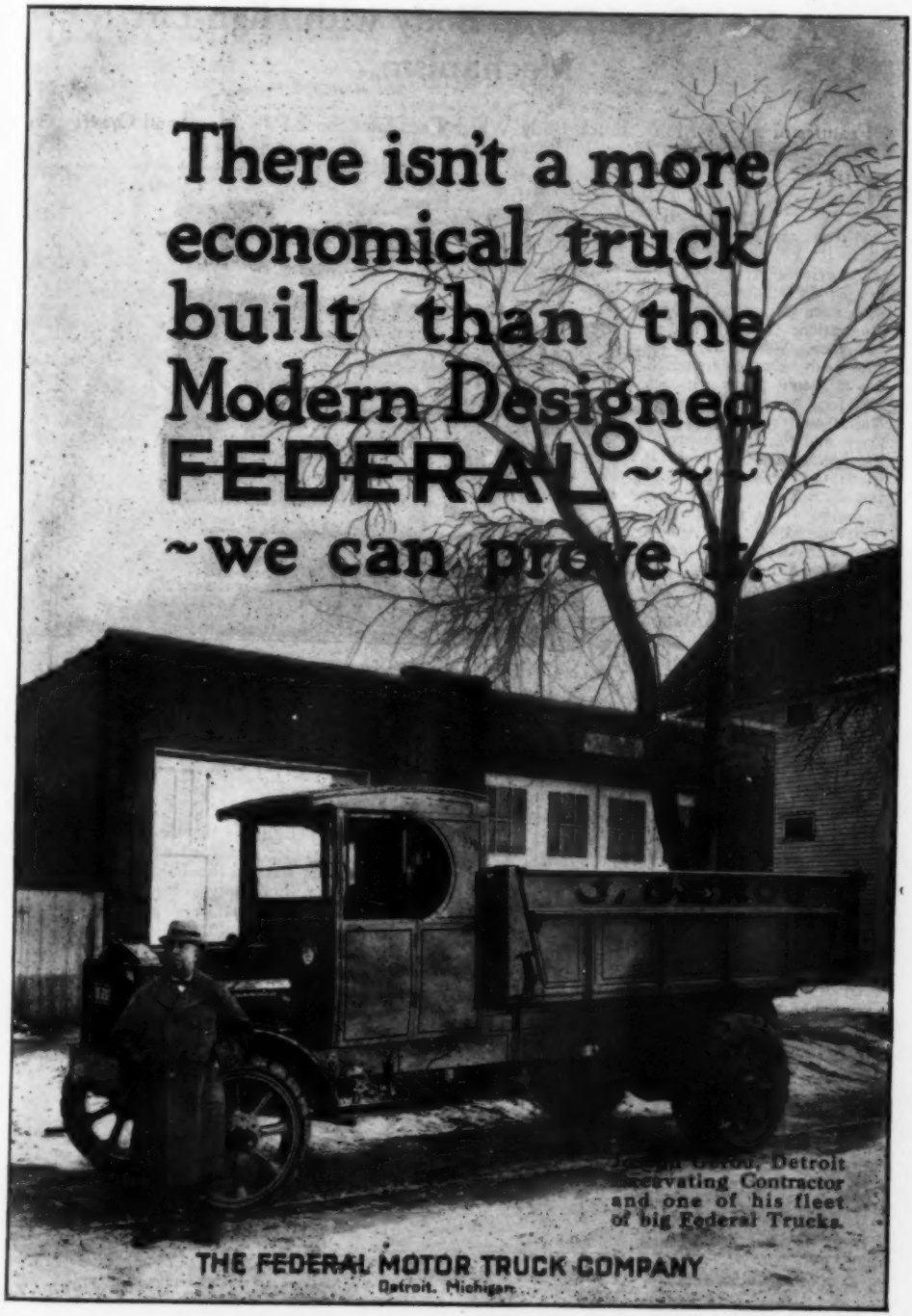
A NEW half-bag mixer built along exactly the same lines as the larger Smith tilting mixers, which have been known to contractors for over 20 years, has recently been placed on the market by the T. L. Smith Company of Milwaukee, Wis., and is known as the Smith 375 tilting mixer. The double-cone drum, the central gear ring and roller track, and the independent tilting frame are the same as in the larger size mixers. The double-cone drum makes fast continuous production and speedy discharge possible. The tilting lever operates easily and locks into discharge position, the drum returning to the mixing position automatically as soon as the lever is released, thus avoiding wasted time and effort.

FOUR-WHEEL MODEL OF MIXER WITH LOW CHARGING PLATFORM

The new mixer has a mixed batch capacity of 3¾ cubic feet, or a complete half-bag batch of 1:3:6, with materials containing the usual 40 per cent voids. In spite of its small size, it is claimed that this mixer is the best-made machine in the Smith line, because of extremely rigid inspection and very close tolerances. The main drive gear and the engine pinion are machine-cut, and the bevel drive pinion is made of 40 per cent carbon electric steel. The chilled thrust rollers have enclosed dust- and moisture-proof ball bearings. The bolster castings are of electric steel, and the operating levers of malleable iron. The power-plant consists of a 1½-horse-power Fuller & Johnson engine, equipped with a magneto, and is completely housed. The feed chute is made of No. 12 gage steel plate. The charging platform is built of 1½-inch boards bolted to heavy steel angles. The platform is 30½ inches from the ground and measures 32 inches wide by 42 inches long.

This new tilting mixer is built in two models. Model RW-1 is equipped with two pressed steel wheels fitted with clincher rims for 30 x 3½-inch pneumatic tires. Model SW-1 has four steel wheels, 24 inches in diameter, and 3-inch grooved treads. The axles on both the wheels are made of cold-rolled steel, 1¼ inches in diameter.

TWO-WHEEL MODEL OF NEW TILTING MIXER WITH RUBBER-TIRES FOR EASY TOWING FROM ONE JOB TO ANOTHER AT HIGH SPEEDS

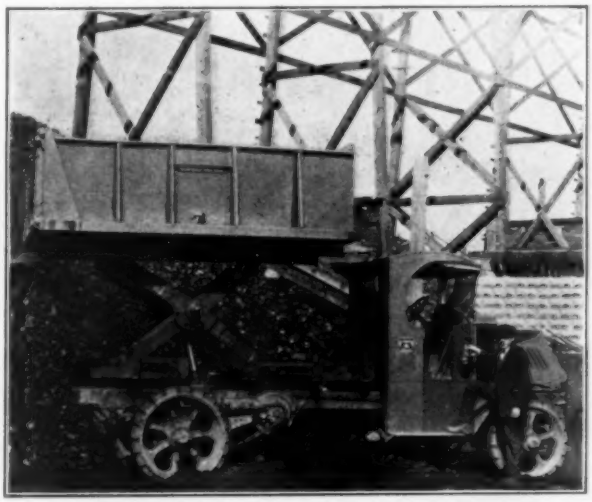

There isn't a more economical truck built than the Modern Designed FEDERAL ~ ~ ~
~we can prove it.
Detroit
cavating Contractor
and one of his fleet
of big Federal Trucks.
THE FEDERAL MOTOR TRUCK COMPANY
Detroit, Michigan

A New Steel Dump Body with High-Lift Mechanism

Features of a New Motor Truck Body Which Facilitates Stock-Piling Sand and Gravel

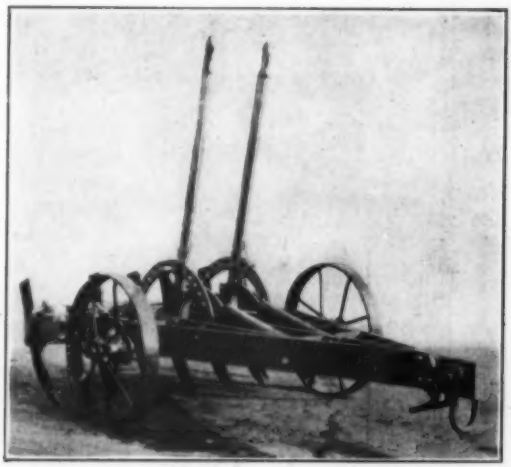
THE need of a truck body which can be raised with its full load to a considerable height above the chassis has led to the development of the Hydro high-lift mechanism, shown in the accompanying illustration, by the Heil Company, Milwaukee, Wis. The body shown, mounted on a 5-ton Mack chassis, has four separate dumping angles of 12½, 25, 35 degrees and the full extent of the high lift. The body is lifted to 3 feet 5 inches, 6 feet 6 inches, and 8 feet 9 inches from the ground. This mechanism has shown its particular value in stock-piling sand and gravel and other material used by contractors.

The body, loaded with 9 tons of gravel, has been elevated to the full height of 8 feet 9 inches without developing any strain.



MACK TRUCK EQUIPPED WITH HEIL HIGH HOIST SHOWING BODY IN TOP POSITION

A New Scarifying Machine



A COMBINED SCARIFIER AND ROOTER FOR ROAD CONTRACTORS

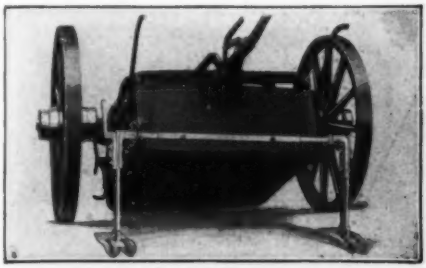
A NEW piece of paving equipment under the name of Graderooter, has recently been brought out by the Lakewood Engineering Company, Cleveland, Ohio. It is claimed that this machine, illustrated below, is particularly useful in scarifying the subgrade preliminary to mechanical subgrading. It can be used also for practically all of the scarifying work found on the average road job, and is built very heavy to stand up under severe service. Some contractors are using this in place of a rooter plow, and it is also being used for maintenance work by state and county highway departments.

The Graderooter is furnished with two sets of five teeth each and one special manganese tooth alone for particularly heavy work. The machine weighs about 1,300 pounds and is furnished for tractor or team hitch.

This machine should prove helpful in providing a construction unit of twofold service for the contractor.

Mr. Contractor!

Equip your Wheelers with
KOST-KUTTER Dumpers—Cost $25.00



Save the hire of one or two men.
Pays for itself every 30 days.
Guaranteed to Satisfy!
Try it for 10 days, if you are not satisfied, return it, we will REFUND YOUR MONEY!
Order from your Dealer or direct from

The Kost-Kutter Equipment Co.
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A Smoother Surface in Far Less Time

That's what every concrete road builder is looking for. Abram "Long Handled" Tools offer you these and many other advantages.

They allow one man to do the work of a gang of ordinary finishers. They do away with the customary "waves" and give you a surface free from creases. Last but not least, they will save you 80% of finishing costs.

Study the insert—the far edge raises when you push, the rear edge when you pull.

ABRAMS CEMENT TOOL CO.

3818 Grand River Avenue, Detroit, Mich.

Adams Grader, with Back-Sloper attachment, building a flat-bottom, back-sloped ditch.

BETTER WORK— AND MORE OF IT

ADAMS Adjustable Leaning Wheel Graders not only do better work, but do more of it per day or per dollar of operating cost.

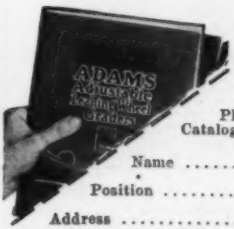
The adjustable Leaning Wheels of an Adams Grader lean the weight of the grader toward and balance it against the side load of dirt which is being moved, thereby counteracting the side pressure that causes other graders to skid out of line and waste power trying to stick to the job.

That's why Adams Graders do not skid, but run easily, cut evenly and move a capacity load, with less power and at lower cost than other graders.

And with Adams Back-Slopers and Blade Extensions, these graders are the ideal machines for a wide range of ditch-building and maintenance work.

Let us show you what other road contractors and engineers are doing with Adams Graders. Mail the coupon, today.

ADAMS
Adjustable Leaning Wheel
GRADERS



C.E.M. 6

To
J. D. Adams & Co.
Indianapolis, Ind.

Please send me your new Catalog and full information.

Name .....

Position .....

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How Wagons Are Cutting Hauling Costs

Tractor Hauls Wagon Train Over Rough Ground with Ease

A NUMBER of contractors have found that hauling a train of wagons with a heavy tractor has materially cut their dirt-handling costs. Charles E. McCrodden, on a grading job in Brooklyn, N. Y., used Watson wagons with a train hitch behind a Holt Caterpillar tractor. There were three wagons to the train, and 180 wagon-loads a day were handled at a cost of about $30, including depreciation.

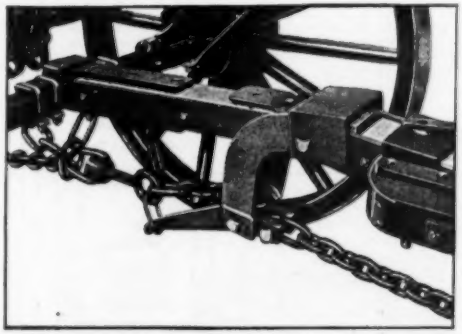
On the big Baltimore Stadium job, H. O. Firor, contractor, Baltimore, Md., used four 3-yard Watson wagons in a train drawn by a Holt tractor and found that they were able to handle 114 trains of approximately 15 yards per train, working 13 hours. This was the best record, but was closely approached in regular work. The cost of the three trains, including labor, gasoline and oil, repairs, depreciation and insurance, amounted to $78.83 per 10-hour day. Considering the amount of material moved in 10 hours, a cost of 5.99 cents per yard was very low.

TRACTOR AND WAGON TRAIN ON THE BALTIMORE STADIUM JOB, ON WHICH THEY MOVED 1,710 YARDS OF DIRT IN TEN 3-YARD WAGONS IN A 13-HOUR DAY

A TRAIN OF WAGONS ON GRADING JOB IN BROOKLYN, N. Y., HANDLED 180 2-YARD LOADS A DAY BEHIND A HOLT TRACTOR

The Watson train hitch for wagons has again placed these units in lively competition with the motor truck, and since there is no motor, the depreciation of the equipment is much lower than the investment, much smaller. With three wagons in a train hauled by a tractor, there is only one motor to get out of order, to 10 to 20 yards of hauling capacity. If the tractor should fall down, which is not likely with its present development, it is only necessary to slip poles into the wagons and use them with horses.

The train hitch which has been developed by the Watson Truck Corporation, Canastota, N. Y., is a novel, but practical, device. In hauling a train of two or three wagons, the entire strain does not come on the draw-bar of the first wagon, but is carried by a chain which extends beneath all the wagons in the train. The draw-bar of each individual wagon is attached to the chain, and the hook by which the individual wagon is attached is so constructed that it takes up all of the slack in the chain. The coupling pole in the Watson train hitch is flexible and moves up or down with every unevenness of the road, thus preventing any pinching or twisting of the rear axle. The wagons follow closely and track evenly, with no swaying from the track, even over the roughest going.

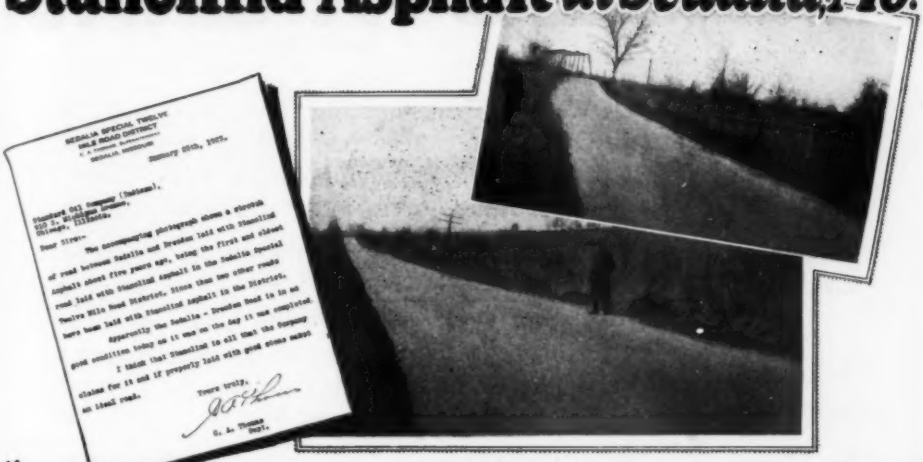


A WATSON WAGON COUPLER HITCHED READY TO START

Where the roads are hard-surfaced, the scenery may be commonplace, but the car ahead can't throw it in your face.

—Bob Quillen.

Stanolind Asphalt at Sedalia, Mo.



"All that is claimed for it!"

VERY few pavements have the hard wearing traffic that falls to the lot of the average country road, and the Special Twelve Mile Road at Sedalia, Missouri, is no exception. Automobiles and trucks, tractors and wagons, loaded and unloaded, all conspire to effect its destruction.

To stand up under these trying conditions, the road was constructed with *Stanolind Paving Asphalt.* The letter from Mr. C. A. Thomas, Superintendent of the Sedalia Special Twelve Mile Road District reproduced above, indicates that *Stanolind Paving Asphalt* is the ideal material for such roads and "all that the Company claims for it."

To those who are responsible for the upkeep of the roads in their community, low maintenance cost is important, as the money allowed by tax payers usually does not provide for a large up-keep expense.

This Sedalia road, which was laid in 1918, has required a minimum of maintenance since, and as Mr. Thomas points out, it is apparently in as good condition today as the day it was completed. In fact the service given by this road has resulted in the use of *Stanolind Asphalt* for paving two other roads in the District.

Hundreds of miles of country roads throughout the middle west, constructed with *Stanolind Asphalt* years ago, are still in the best of condition, proving that the experience of Mr. Thomas is not exceptional. More examples and details will be gladly supplied on request.

We have recently issued a booklet which tells the latest methods of constructing and maintaining bituminous pavements. It will be sent to you free, upon request.

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CALCIUM CHLORIDE

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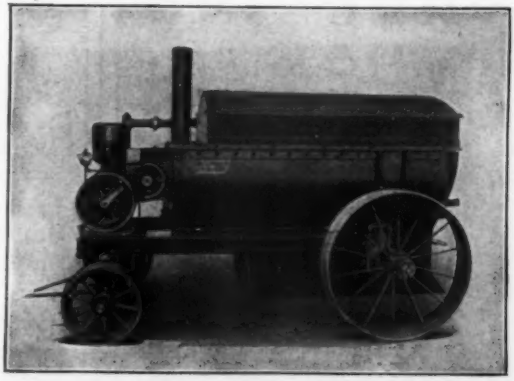

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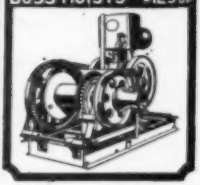

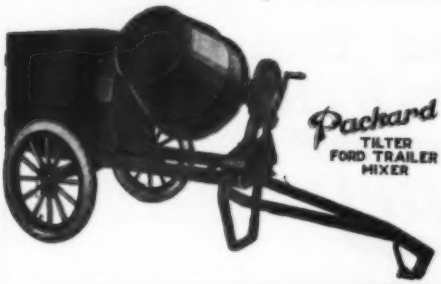

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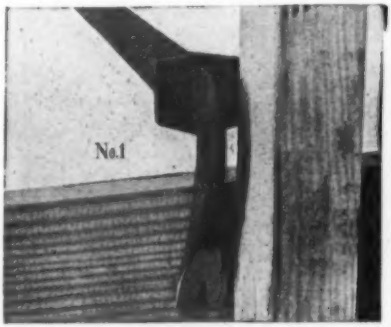

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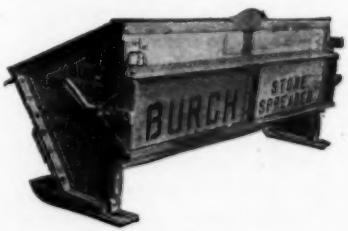

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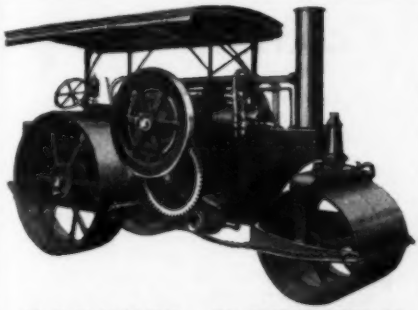

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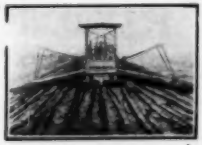

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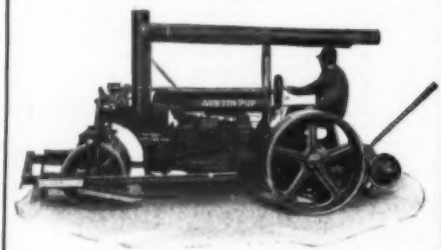

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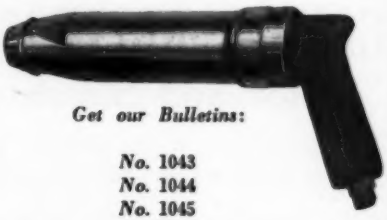

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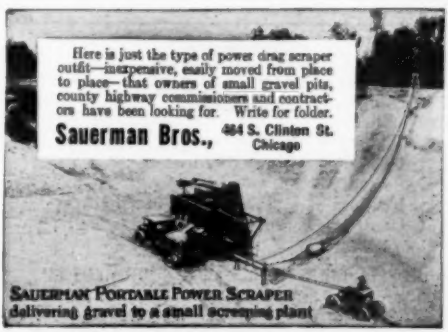
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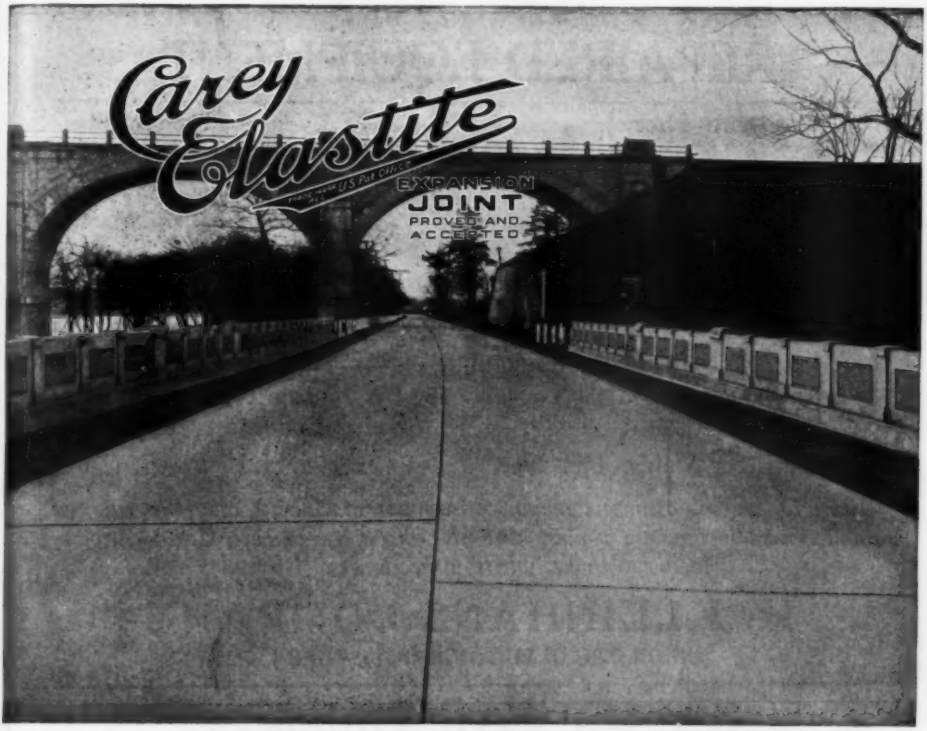

Mercer County Highway near Trenton, New Jersey. H. F. Harris, County Engineer, Ross & Whelan, Inc., of Trenton, N. J., Builders. Elastite Expansion Joint used.

Good roads—good reputations

A GOOD road, completed on schedule according to contract, means full profit to the contractor and another success added to the engineer's record.

Expansion joint is the smallest item on the road material bill, yet non-delivery or delayed delivery may hold up the whole job. It doesn't pay to take a chance on any other joint when you can always be sure of getting Elastite Expansion Joint when and where you want it.

The annual production capacity of the Carey factory making Elastite Expansion Joint is greater than the total national consumption of pre-formed expansion joint! Also, big stocks are carried at seventeen distributing centers to give quick shipment on all orders.

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The wide demand for Elastite Expansion Joint over many years has made possible the creation of factory and distributive facilities that assure prompt deliveries anywhere in any quantity

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1873—Fifty Years of Progress—1923

Carey Elastite Expansion Joint is an asphaltic body, formed of a high-grade asphaltic compound carefully refined and tempered, sandwiched between two walls of asphalt-saturated felt forming an elastic, compressible joint. It is made in lengths, widths and thicknesses as required, can be cut to crown or to any special shape and comes to the job ready to use.

6-23

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2—Type "B" Erie, ¾-yd., traction wheel, standard booms, shop numbers 206 and 312.

1—Type "B" Erie, ¾-yd., traction wheel, high lift, shop number 914.

3—Model 28 Marions, ⅝-yd. dipper, traction wheels, shop numbers 3134, 3137 and 3229.

4—Model 60 Marion RR type, 2½-yd. dipper, shop numbers 1995, 1999, 2059 and 2372.

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Distributors of Contractors' Equipment

THE following cards (arranged by states) show the names of dealers in contractors' equipment and supplies with a record of the various lines handled. Contractors will find this list a convenient means of getting in touch with dealers who make a point of giving satisfactory service and prompt shipments. This directory is constantly consulted by our subscribers and any suggestions regarding it will be welcomed. ⁘ ⁘ ⁘

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"HAYWARD" Orange Peel Buckets
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"CLIPPER" Blast Hole Drills
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"HAISS" Portable Loaders
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"MINSTER Locomotives
"HOTCHKISS" Forms
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1828 Los Angeles St., Fresno, California

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The Ironton Engine Co., Storage battery locomotives.
Insley Mfg. Company, Concrete handling equipment, steel derricks, industrial cars.
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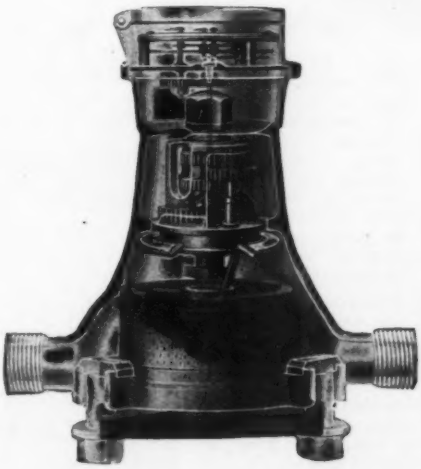

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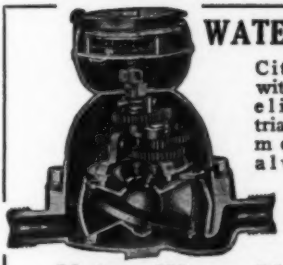

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